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ABSTRACT

This report examines the immediate and underlying causes of malnutrition in the developing world. The first section discusses the effects of malnutrition on childhood development and examines the efficacy of nutritional rehabilitation. The second section addresses the medical effects of severe malnutrition, including the onset of ponderostatural (weight) retardation, behavioral disorders, dehydration, anemia, hypothermia, hypoglycemia, and diarrhea. The third section focuses on anthropometric approaches to treating malnourished children, which treat children on an individual basis based upon their particular condition. The fourth section examines the biological effects of severe malnutrition, discussing deficiencies in serum proteins, electrolytes, trace elements, and hormonal levels, along with their immunological consequences. The fifth section explains the nutritional approach to the problem, looking at protein, vitamin, and mineral deficiencies and specific rehabilitation procedures and foods. The sixth section focuses on a cultural approach to malnutrition, discussing dietary and social customs that affect nutrition and eating behaviors. The seventh section examines psychological approaches, looking at the mother-child relationship, psychological problems fostered by malnutrition, and specific interventions. The eighth section addresses social and economic approaches to malnutrition, while the ninth section examines techniques used to evaluate rehabilitation and treatment programs. (MDM)

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SEVERE MALNUTRITION : A GLOBAL APPROACH

1993 - N° 208-209

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INTERNATIONAL CHILDREN'S CENTRE - PARIS

The International Children's Centre was created by the French government in 1949, on the initiative of Professor Robert Debré in particular, following negociations between France and the United Nations. Its purpose was to furnish those international and national agencies dealing specifically with child care with training facilities and educational and informational tools in the field of child health and development, viewing children within their family and surroudings.

ICC soon turned essentially toward Third World children and devoted its activities to the training and education of personnel with social, educational and administrative responsibilities as well as medical and paramedical workers.The desire for greater efficiency has led it to work increasingly with trainers and to concentrate its efforts on the methodological and educational aspects of mother and child care programmes.

ICC is also engaged in an attempt to further study - and - action on some aspects of the life and health of children and their family, so as to contribute to practical improvement, particularly in the fields of growth, nutrition, planned parenthood, the control of transmissible and nutritional diseases, preschool and school education, the needs of disabled and underprivileged children, etc.

The documentation centre of the ICC has been collecting, processing and circulating invaluable information on children and their environment for the past forty years. In the last decade the centre has also developed the Robert Debré Database (BIRD) ; with its current 110,000 references, it can meet your bibliographic research needs either by correspondence or by visiting the centre's library. Furthermore the ICC also produces the BIRD CD-ROM, updated yearly with the latest database references; it is a user-friendly compact disc operated on any IBM compatible PC equiped with a standard CD-ROM drive. ICC also publishes books, proceedings of symposia and educational documents, as well as comprehensive analyses and bibliographic bulletins.

As for its legal status, the International Children's Centre is a foundation under french law of recognized public utility, administered by an executive board with broad international membership.

CHILDREN
IN THE TROPICS
REVIEW OF THE INTERNATIONAL CHILDREN'S CENTRE

SEVERE MALNUTRITION : A GLOBAL APPROACH

☐ JEAN-GÉRARD PELLETIER

1993 - N° 208-209 4

On Sunday, 10 October 1993, Professor Djilali BELKHENCHIR was assassinated by several young men, in front of his paediatric department at Birtraria, in Algiers.

He had often worked with the ICC on subjects such as the behaviour of adolescents and the evaluation of health programmes, sharing with us his sound competency, broad experience and profound philosophy, which he never failed to put into everyday practice, and which may be summed up in a very few words : "children first".

His 1985 doctoral thesis in medicine, on infant diarrhoea, for which he earned the Nathalie Masse award, was prefaced by the following dedication :

"I dedicate this thesis to young Omar SAADI, who died in the battle of Algiers at the age of 11, because he believed that justice could be achieved in this country. To all those little fellows out on the streets throughout the world, who die each day, standing side by side with their elders, for the same ideals."

We hope that all those who knew and appreciated him are as deeply affected as we are, and will uphold the memory of his example.

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Jean-Gérard
PELLETIER

In 1989-90, Jean-Gérard Pelletier worked in Cochabamba, Bolivia, within a team of young Bolivian practitioners who were trying to put this global approach to severe infantile malnutrition into everyday practice. Their rehabilitation centre, run by Dr. R. Sevilla, is located in the paediatric department headed by Dr. Lopez within the German Urquidi Hospital.

The author of the present document takes entire responsibility for everything it contains, but wishes to state that his experience within this very dynamic team was most valuable for the formulation of this overview. He expresses his thanks to :

- Dr. R. Sevilla and Dr. E. Sejas, paediatricians,
- Dr. P. Brun (French non-governmental humanitarian agency, "Aux Quatre Coins du Monde"),
- Ms. M.L. Flores and Mr. J.C. Lafuente, students of psychology,
- Mr. P. Chevalier, nutritionist at the ORSTOM,
- Ms. L. Zalles, biologist and Ms. E. Suarez, student of sociology, the nurses and nurses' aides.

In 1988, a Centre for Complete Nutritional Rehabilitation, the CRIN, was created in Cochabamba, Bolivia, on the initiative of a group of nutritionists from the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM) and young paediatricians from Bolivia's San Simon University, supported by the French Embassy in Bolivia, "Aux Quatre Coins du Monde", a nongovernmental agency, and ORSTOM.

The objective of the CRIN, which works independently within the paediatrics department of the German Urquidi Hospital, goes beyond the clinical and nutrition-related rehabilitation of severely malnourished children, to include the satisfaction of their basic emotional, cognitive and psychomotor needs, the restimulation of their immunocompetence and an attempt to improve the environment in which these children will again be immersed at the end of their hospital stay.

This holistic approach to the treatment of severe malnutrition, based on the action of a pluridisciplinary team, the CLAPSEN (Clinic, Laboratory, Anthropometrics, Psychology, Socioeconomics, Education, Nutrition), was the object of an international workshop on complete nutritional rehabilitation (SIRIN), in June 1990, the conclusions and recommendations of which have been published (*).

Dr. J.G. Pelletier was a member of this group for close to one year (1989-90). It is this experience, and his reflections on the CRIN and its activities, along with a critical examination of writings on the subject, which have enabled him to write this overview of the global approach to severe malnutrition.

SECRETARIAL WORK SYLVIANE LE BIHAN

TRANSLATION HELEN ARNOLD

(*) *"Del niño desnutrido a la comunidad", conclusions and recommendations of the SIRIN, Cochabamba, Bolivia, ORSTOM-IBBA-UMSS-MPSSP, La Paz, 1990.*

REHABILITATION : GLOBAL CARE?

MALNUTRITION HAS NUMEROUS CAUSES

Although the main cause of malnutrition is the qualitatively and quantitatively insufficient intake of food, a closer study of its aetiology points to a great many other interdependent factors.

These factors, which may be contributory, triggering or precipitating, have been described repeatedly, and some scientists have even proposed models to evidence their origins, inter-relations and various levels of responsibility (national, regional and also local - that is, village or household levels). If the personnel, communities and families concerned are aware of and understand these mechanisms, perhaps they will be better armed to identify the key factors, and will thus find solutions that are better adapted to both needs and resources, and therefore more productive, in terms of efficiency.

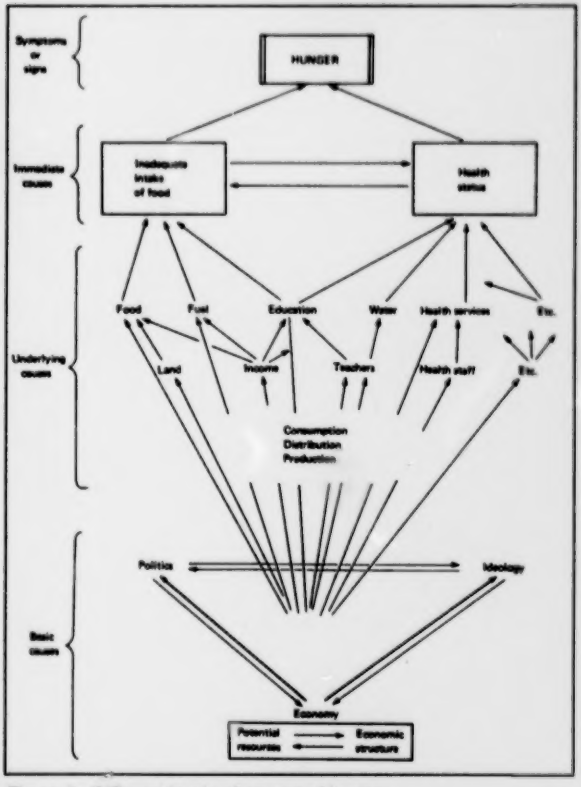

Figure 1 : Different levels of causes of hunger.
Source : Jonsson U. "The Causes of Hunger". Food and Nutrition Bulletin. UNU, april 1981 ; 3, (2).

These models, which do not confine themselves to nutrition and health-related factors, but take a comprehensive approach, identify the various aetiologies involved in malnutrition. Malnutrition is not simply a childhood disease. Its causes are indicative of precarious living conditions and a more or less unsatisfactory environment as well. Treating malnourished children means treating the consequences of an ill that is rooted in many sources located above-stream, and in which a number of sectors are involved. Treating malnourished children means working with them within their family and everyday surroundings (cf. figure 1) (1).

(1) Jonsson U. "The causes of hunger". Food and Nutrition Bulletin. UNU, april 1981 ; 3, (2).

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This figure clearly illustrates the approach required for the study of the causes of malnutrition ; it supposes a long-term project, and one which must be carried out with the participation of families, social and health field workers, but also with many people in charge of the other sectors involved (sanitation, food production, the economy, commercialisation, education, law-making, politics, informal associations, etc.). The cultural and religious aspects should not be overlooked, since they play a key role in everyday behaviour, eating habits and attitudes toward health, illness and death.

Mothers and children : the vicious circle of malnutrition

Malnutrition is self-perpetuating : a child's nutritional status at any point in time depends on his or her past history, which may partially account for his or her present status. To some extent, this nutritional history is linked to the mother's health and nutritional status, which in turn has been influenced by her living conditions and nutritional history during her own childhood (cf. figure 2).

Short stature in women may be interpreted as one consequence of poor diet during growth ; they then run the risk of giving birth to children with a low birth weight, a factor possibly contributing to the occurrence of malnutrition. Furthermore, these women often have an insufficient diet during their pregnancy, along with numerous infections.

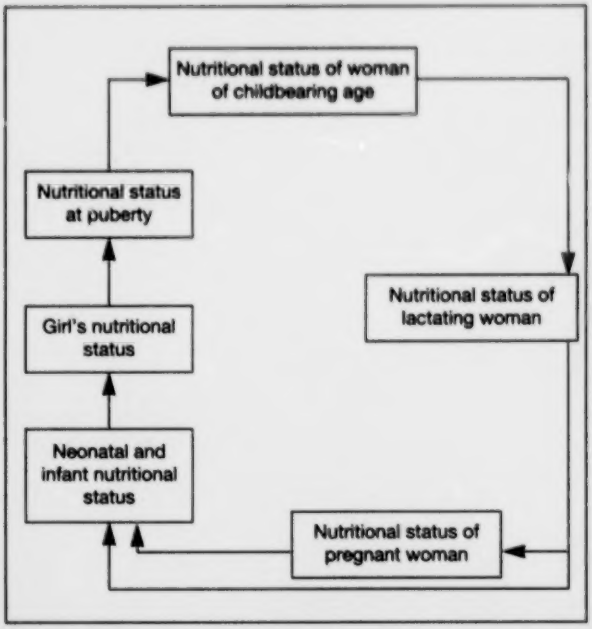
Nutritional status of woman of childbearing age
Nutritional status at puberty
Girl's nutritional status
Neonatal and infant nutritional status
Nutritional status of lactating woman
Nutritional status of pregnant woman

Figure 2 : Influence of each generation's nutritional status on the following generation.

There are other maternal risk factors : a weight for height far below normal at the onset of pregnancy, insufficient weight gain during pregnancy (under 6 kg), overly frequent pregnancies (separated by less than 6 months), pregnancy before age 15, multiparity (over five children), and a past history of delivery of low-birth-weight babies.

This approach points to the need for interventions to be well targeted : in the long run, action that confines itself to malnourished children cannot solve the problem, and this is one reason why we encounter children who relapse after hospitalization for malnutrition, or several siblings with the same problem. Interventions must take the child's environment - and especially the mother-child dyad - into account, and should also concentrate on adolescence in girls, a crucial period for future mothers.

Severe malnutrition and childhood development

Malnutrition may occur at different ages corresponding to more or less sensitive periods of the child's psychomotor development, it may last for varying periods of time and be more or less severe. It may be due to specific qualitative and quantitative deficiencies. In other words, there are many types of malnutrition, rather than one single form. Some studies indicate that the growth retardation evidenced in cases of severe malnutrition tends to be related more to the duration of malnutrition than to the severity of the case : the height/age ratio (stunting) seems to be a better prognostic indicator of the long-term consequences of severe malnutrition than the weight/height ratio (wasting).

Retarded growth and psychomotor development occurring during malnutrition are sometimes reversible, and children then recuperate : they may also be permanent, and those children never catch up with their peers of the same age, living in a similar environment.

Some researchers have shown that if severe deficiencies are experienced during the periods of intense development of the brain, they may result in permanent modifications in psychomotor development. For human beings, this vulnerable period is located between the thirteenth week of gestation and the end of the second year of life. It is a fact that during intrauterine life, the mother makes all of her reserves available to the foetus, to afford it, and especially its brain, with as much protection as possible against aggressions.

It is not easy to study the repercussions of malnutrition on development, since a number of factors are at work here and it is extremely difficult to sort out the effects of malnutrition and those depending on the environment (poor hygiene, broken home, lack of stimulation, etc.). Be this as it may, we agree with the many researchers who assert that severe malnutrition occurring during the first two years of the life of a child living in a socioeconomically disadvantaged environment may cause long-term behavioural modifications.

On the developmental level, children who have suffered malnutrition seem to achieve a level of performance comparable to that of well-fed children in similar surroundings, but at a later age. This, according to some Mexican writers, accounts for some of the learning problems, and even the failures, of these children, and above all, for certain difficulties in adjusting to society.

Interactions between environment, nutrition and development

A population's nutritional status depends on the social environment in which it lives : food and diet - good or bad - are an integral part of the social, economic and cultural situation. Environment, nutrition and development are closely inter-related.

There is an intimate link between children's nutritional status and their psychological and emotional environment : Mexican studies have demonstrated the influence on development of an insufficient dietary ration ; it may be mediated by the interplay of a series of subtle relations between the child and his or her surroundings, through diminished motor activity, ability to pay atten-

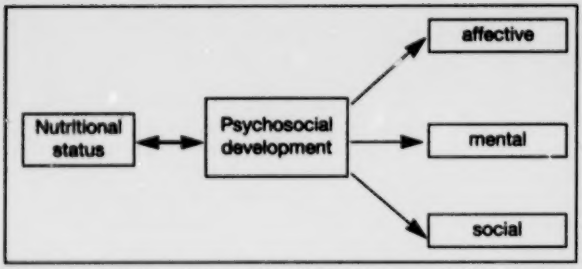

Figure 3 : Relations between nutritional status and child development.

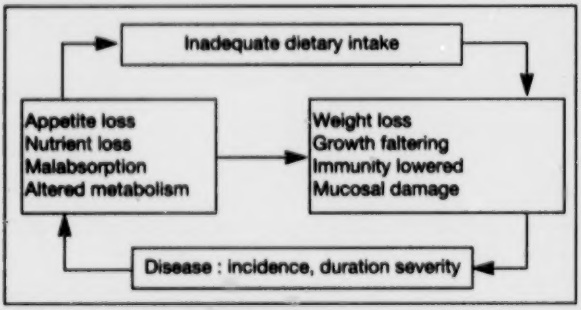

Figure 4 : Malnutrition/Infection cycle.
Source : Tomkins A, Watson F. Malnutrition and infection : a review. ONU/ Subcommitee on nutrition, 1989.

tion or to respond to social stimuli, for instance. As a result, the child encounters fewer opportunities for stimulation by the people around him or her, and therefore has fewer possibilities of attaining more complex achievements. This may also affect the child's eating behaviour, causing a loss of appetite : the child then becomes accustomed to a small ration, and does not express any desire to eat more. Similarly, mothers devote less time to passive children, and the same is true of health workers. All of these factors, be they dietary, economic, sociocultural, behavioural or cognitive, interact in affecting development, while the child reacts, in turn, with synergetic mechanisms that have a multiplying effect.

A great many studies have investigated the positive influence of programmes for the psychological/emotional stimulation of malnourished children, in conjunction with nutritional rehabilitation programmes. There is no need to go into them here. They have been discussed in issue n° 177 of this journal, entitled "Diet, environment and children's development".

There is a synergetic effect between psychosocial stimulation of children and eating : the act of eating involves sensory stimulation and is one way by which they learn about social life. It is a time for exchanges and advances (cf. figure 3).

This synergy between nutrition and psychosocial development is seen to be defective in the history of malnourished children. Two factors are often mentioned : a low level of stimulation and exchanges, and the existence of a passive mother.

Interactions between nutrition, immunity and infection

It is now known that malnutrition reduces the body's resistance to infections, and that infections worsen pre-existing malnutrition (cf. figure 4).

Furthermore, psychological/emotional factors seem to influence immunocompetence, which does not depend on an isolated system, and may be affected by emotional disturbances. Studies on animals have shown that stress may depress the immune system, for instance. Other experiments have pointed to possible

links between the brain and the immune system. All of these interactions, if corroborated, will definitely enhance the concept of the global approach to malnutrition.

The interdependence of these different fields is clearly documented by innumerable investigations (cf. figure 5).

NUTRITIONAL REHABILITATION

The crucial question is whether the aim of reinstating satisfactory growth is an adequate goal for a nutritional rehabilitation programme, or whether there is a need for direct intervention on these children's development, whenever possible.

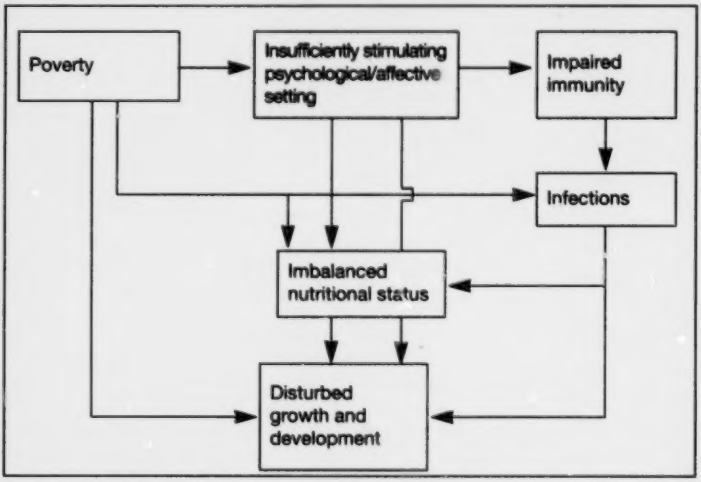

Figure 5 : Interdependencies.

While physical growth may be defined as a relatively simple, biological occurrence, the visible, measurable part of which is a growing body, psychomotor development is a very elaborate transformation process, in the course of which children learn to achieve increasingly complex movements, thoughts, language, feelings, behaviour, knowledge, interpersonal relations, etc. These aspects are all interdependent, and clearly embody the idea of interaction with the environment. It is extremely important, then, for children to be allowed to develop all of their potential to the utmost during the first years of life, which are the formative period for their personality, intelligence and social behaviour.

The scope and goal of rehabilitation are quite clear : it should contribute to a better interaction between children and their environment. Action on the child's diet and nutritional status is a first step, but an insufficient one. If we are to speak of rehabilitation, and to achieve positive - and above all lasting - results, what is needed is actually a therapy that tackles the social and material environment of the individual child and of children in general.

Nutritional rehabilitation should restore the child's multi-facetted potential for development within his or her surroundings, well beyond the purely nutritional aspect ; this requires an approach which is simultaneously clinical, psychological, socioeconomic, cultural and educational.

Home follow-up

Following any nutritional rehabilitation intervention in an institution, children should be followed up at home to avoid relapses, and to make sure that compensatory mother's education and child stimulation programmes have been fruitful. This has been clearly evidenced in a number of studies on recovery in malnourished children, but also during the evaluation of intervention programmes aimed at populations at risk of malnutrition. For groups with a high risk of malnutrition, compensatory programmes are developed in the fields of nutrition, health, education and hygiene, in an attempt to determine the respective responsibility of these sectors in children's evolution, and how long action should last, at the least, if long-term effects are to be attained.

An interdisciplinary effort

The benefits of isolated action conducted by a single individual in his or her own professional framework may very rapidly be reduced to naught. Let us take an example : malnourished children admitted to a nutritional rehabilitation centre often have multiple parasitic diseases, which compound their problem. Treatment against parasites easily overcomes infection, and proper hygiene during hospitalization prevents recontamination. When they return home, children soon catch other parasites. To avoid this vicious circle, action involving people with different competencies is required. This includes health workers to diagnose and treat ailments, educational efforts to teach families the connection between diarrhoea and contamination carried by hands, an understanding of traditional explanations for diseases so that educational messages may be adjusted accordingly so as to be accepted and applied, interventions on the environment to improve living conditions in accordance with resources, attention to psychological aspects to intensify mother-child communication, etc. This approach may seem simple and logical, but everyone who has done field work in a responsible position knows how difficult it is to set it up and to apply it on a day-to-day basis, since the absence of any one link in the chain is enough to upset the entire process.

One key obstacle to comprehensive care is the problem of means, and of human resources in particular. For many units, it is out of the question to employ personnel from such different disciplines as sociology, psychology, etc. If nutritional rehabilitation requires this global approach, and if the nutrition centre opts for this orientation, the centre may begin by coping with the nutritional problem, and gradually adjoin the other aspects by training existing workers in this spirit, and possibly seeking out the help of specialists from other disciplines but with an understanding of the problem of malnutrition, for limited interventions.

A global approach to care for severely malnourished children implies readiness to work with people in disciplines other than health, team work and an education-oriented attitude within the team, but also toward other people in contact with the children.

Improvement of the nutrition situation definitely requires increased awareness, within the communities involved, of the

various aetiologic factors, so that they themselves may find solutions. External, imposed solutions are not necessarily culturally acceptable or adapted to local conditions and constraints.

The causes of malnutrition are numerous, interdependent and of varying impact.

Malnutrition is self-perpetuating.

To break the vicious circle, the child must be given comprehensive treatment within his or her usual surroundings, with special emphasis on the mother-child dyad, so that rehabilitation will affect development as well as growth.

Comprehensive care means acting simultaneously on the surroundings and on the child's psychological and emotional environment, nutrition and pathological conditions.

To be successful in the long term, this care requires follow-up at home.

Comprehensive care demands that health officials whose fields of action are complementary work together as a team. It requires training in different disciplines and open-mindedness toward these.

CLINICAL APPROACH

Malnutrition is produced by deficient or excessive intake of certain nutrients, causing an imbalance which is detrimental to the body.

In developing countries, the most frequent forms of malnutrition are those caused by deficiencies. They include vitamin-deficiency diseases such as xerophthalmia and rickets, mineral deficiencies (such as iron deficiency) causing nutritional anaemia and energy and/or protein deficits responsible for protein-calorie or protein energy malnutrition (PCM or PEM); these three types of deficiency are often combined.

There are mild-moderate forms of protein energy malnutrition and severe forms, including marasmus, kwashiorkor and marasmus-kwashiorkor. Only severe forms of malnutrition will be discussed here, and we will not go into their clinical description, which may be found in any textbook.

SEVERE FORMS OF PROTEIN ENERGY MALNUTRITION

Breast milk is theoretically the infant's only food during the first months of life, after which there is a need to vary the diet because the proteins and calories provided no longer meet the infant's requirements. Weaning, which takes place at varying ages depending on local customs, is a difficult period. The transition from breast milk to an adult-type nutriture requires gradual diversification, and this is not necessarily achieved in a satisfactory manner, for a variety of reasons.

The child may then suffer from a silent form of malnutrition, either of kwashiorkor (essentially a protein deficiency) or marasmus (predominantly a deficit in energy). These two deficits are usually combined.

MARASMUS

Ponderostatural retardation

Marasmus remains latent for several weeks, with no visible signs with the possible exception of a faltering growth curve. The clinical signs develop particularly fast when the child is in a rapid growth phase (during the first year of life) and when he or she had a low birth weight. Weight is mainly affected ; often the child's weight is below 60 % of the theoretical weight for age ; height tends to be subnormal, but faltering finally ensues if the caloric deficiency continues for too long.

Wasting of muscles and fatty tissues

The muscles and fatty tissues clearly waste away : the extremities are emaciated and jut out (prominent ribs and limb bones), the face is wrinkled, old-looking : debility is the main sign of full-blown marasmus.

Behavioural disorders

Anorexia is far from being constant : the child is hungry but unable to accept large amounts of food, and vomits easily. Hunger is reflected in his or her eyes. These puny, emaciated children remain alert, and they anxiously scrutinize the personnel around them. They are tired, restless and get little sleep.

Damaged skin, hair and nails

Some minor anomalies affect the hair, which is sparse, thin, and dry.

The skin is thin, flaccid, loose, wrinkled, and seems to be too large for the body ; this is what makes the face old-looking, as well. The bones and tendons are visible under the skin, but no skin lesions are present.

Theoretically, there are no chronic digestive disorders, constipation is to be expected but diarrhoea, with small, blackish or greenish glairy stools, known as "hunger diarrhoea", or else ordinary diarrhoea caused by an infection or a parasitic disease, may be encountered.

Although marasmus may occur at all ages, it is usually seen during the first year of life when breast-feeding is disturbed, or in artificially fed infants.

Actually, this is all quite theoretical : the definition of two separate entities - marasmus, a wasting disease with no oedema, and kwashiorkor, oedematous protein malnutrition - is essentially clinical. Pathophysiological investigations of these two conditions tend to show that both have complex, multifactorial origins.

KWASHIORKOR

Kwashiorkor is a Ghanian word meaning "the sickness affecting children deprived of their mother's breast". Clinically speaking, there are some constants, while other signs are occasional. The constant signs include oedema, ponderostatural deficit and behavioural disorders.

Oedema

Oedema, or swelling, varies in extent but is always present, especially in inclined parts. It may affect the trunk, the face, the hands and feet and external genitals. It is soft and shows pitting. Usually it represents from 10 to 30 % of the body weight, but this figure may be as high as 50 % in severe cases.

It may coexist with severe dehydration, since sodium and water retention are not evenly distributed throughout the extracellular fluid chambers.

In uncomplicated PEM the serous membranes are usually not affected, but in severe cases fluid may accumulate in the peritoneal, pleural and pericardial cavities. This swelling masks the wasting of muscles, which only becomes visible once the former has receded.

Ponderostatural retardation

Weight is located between 60 and 80 % of the reference figures for the child's age. Muscle wasting is often masked by the persistence of the subcutaneous connective tissue, and by swelling, which sometimes makes the baby look chubby.

Both head circumference and length are affected, but the length curve is not too seriously touched, whereas the weight curve definitely falters. This faltering is masked by the oedema at first, and it is only after the swelling disappears that the retarded weight for length becomes evident.

There is serious muscular atrophy (since the child has been living on his or her muscle protein reserves), resulting in axial hypotonicity of the paravertebral muscles and distension of the abdomen ; rectal prolapse is not unusual.

Skeletal age is retarded. X-ray of the skeleton shows a reduction in the thickness of the cortical region of the bones, with osteoporosis. Last, dental hypoplasia is present.

Behavioural disorders

The child is grumpy and cries characteristically when approached, with tearless whining at the slightest touch. He or she is sad and apathetic, fearful and introverted. A miserable, expressionless face and a fixed gaze complete the picture of a child who is indifferent or hostile to everything around him or her, and refuses all food : anorexia is a constant symptom. All of this complicates nutritional and psychomotor rehabilitation. Despite this picture, there are no neurological disorders. Orality is disturbed, as are relations with the mother. Malnourished children are emotionally disturbed children.

Other signs

Other signs may be present, but are not constant. They include damage to the skin, hair, nails and mucous membranes.

Skin damage

Pigmentation disorders may be observed, with hyper and hypopigmentation : discoloured areas coexist with dark, hyper-pigmented patches. The elasticity and structure of the skin may be impaired : it becomes dry, wrinkled and fragile, with occasional detachment, closely resembling severe burns. Alongside the dry, scaly, cracked skin, desquamation of extensive areas uncovers a pink, moist epidermis, through which proteins are lost and superinfection occurs. These impairments are specially frequent in the regions exposed to injury and to maceration, around the perineal and inguinal regions, and extending to the buttocks, the posterior side of the thighs and the armpits. Fissuring often occurs on the perineal folds and behind the ears. There is no local inflammation of the ulcerated skin. The skin is thin, smooth and shiny in the oedematous regions.

Damage to the hair and nails

The hair bulb, at the base of the root, is damaged, so that it may be plucked out easily and painlessly. Hair becomes discoloured, brittle, thin and straight. Africans lose their kinky hair and sometimes become red-headed or blond, or worse still, children become bald. The eyebrows may be affected as well, whereas the eyelashes grow, and may be long and thick, while the body is lightly covered with downy hair. The nails grow slowly, and may change colour as well.

Damage to the mucous membranes

The lips are affected with cheilosis and rhagades. The oropharyngeal mucosa may be atrophied and fragile, and are often covered with thrush, the tongue depapillated, the gums infected. Anal or vulvar fissures are frequent.

Hepatomegaly

Autopsies consistently uncover steatosis of the liver and only occasionally hepatomegaly, but there seem to be geographic variations in the frequency of the latter. The liver is smooth, regular

and often soft, and may touch the iliac crest. The increased size is caused by an accumulation of fat, mostly triglycerides. The enlarged liver may occur in conjunction with pandemic infections such as malaria and kala-azar. Signs of impaired liver functioning such as petechiae or a slight increase in bilirubin are indications of a poor prognosis.

Enlargement of the parotid is usually associated with oedematous malnutrition, but may also occur in children with marasmus.

MARASMUS-KWASHIORKOR

Often a combination of signs of marasmus and of kwashiorkor are seen, forming an in-between picture of severe PEM. Oedema is present, and body weight is below 60 % of the reference figure for the child's age. The prognosis is very poor in such combined cases, and the death rate is higher than in pure kwashiorkor.

In latent or mild-moderate protein energy malnutrition, the first indication is faltering weight, visible essentially on the weight curve if it has been charted regularly. When the case of malnutrition has been developing silently for several months, the child may be a "nutritional dwarf", clinically speaking. Weight and height are below the reference figures, but the child is well proportioned, with a harmonious appearance but looks much younger than he or she actually is.

DIFFICULTIES IN TREATMENT

The resuscitation phase is often particularly delicate in severely malnourished children, owing to accompanying dehydration.

DEHYDRATION AND FLUID AND ELECTROLYTE DISORDERS

Diagnosis is a problem in marasmus, since the wrinkled skin makes it difficult to interpret the skinfold, and also in kwashiorkor, since severe dehydration with collapse may occur despite the oedemas. Indeed, in kwashiorkor, hypoalbuminaemia is partially responsible for directing water into the tissues ; oedemas do not necessarily mean that water is present in excess, but rather that it is poorly distributed within the body, with a low blood volume. Diarrhoea may further increase this dehydration. Swelling masks the size of any subsisting skinfolds : these sometimes remain visible on the upper part of the body, which is less affected by oedema.

Dehydration is diagnosed on the basis of dry mucosa, anuria or oliguria and tachycardia.

When rehydrating kwashiorkor cases, several dangers lurk :

- infused fluid may not remain in the vascular system, but may further compound oedemas, because of the impaired distribution of fluids. In severe dehydration, then, albumin or an equivalent (large molecules, blood) should be given along with rehydration, so that the infused fluid will remain in the vascular system ;

- given the considerable risk of heart failure, the child should be rehydrated extremely gradually. Furthermore, despite subnormal or really low ionographic figures, there is actually an excess of sodium in the body : it is important to avoid giving too much salt, which would be conducive to heart failure ;

- the usual potassium deficit, often compounded by diarrhoea, should be corrected to avoid the development of heart rhythm disorders.

Moderate dehydration

In moderate dehydration, infants evacuate four to ten stools a day, are intensely thirsty, with somewhat sunken eyes, a moist mouth and normal blood pressure. The WHO rehydration solution should be diluted by half, especially in case of kwashiorkor. The solution should be renewed every twelve to 24 hours, and should not be boiled : 50 ml/kg are given orally during the first four hours, followed by 100 mg/kg during the next twenty hours.

Table 1
ORS

Ingrédients	Grammes
Sodium chloride	3.5
Sodium bicarbonate	2.5
Potassium chloride	1.5
Anhydrous glucose	20.0

Some teams recommend the use of locally prepared rice water and electrolytes for oral rehydration. To obtain one litre of rice water, two handfuls of rice are cooked in one and a half litre of water. When the rice is cooked, it is drained off, and the equivalent of a flat beercap-full of salt and eight lumps of sugar are added to the water.

The child's clinical state - resumption of diuresis, pulse, breathing, consciousness - is assessed frequently.

If vomiting makes active oral rehydration impracticable, gastric tubage is required, with continuous forced feeding, or small amounts given hourly.

Severe dehydration

In severe dehydration, use of infusion should be avoided whenever possible, except for the resuscitation of seriously dehydrated children in a state of shock (rapid, unmeasurable pulse, cold hands and feet, collapsed blood pressure). The child evacuates more than ten stools a day, vomits frequently, is intensively thirsty but unable to drink, has oliguria, impaired consciousness, sunken eyes and a very dry tongue. Venous rehydration is then imperative. The method depends on the available resources :

- transfusion of whole blood (10 to 20 ml/kg), provided the risk of AIDS has been eliminated ;

- infusion of Ringer's lactate solution, at the dose of 70 ml/kg within a three-hour period, followed by an infusion of glucose plus electrolytes ;

- a third possibility is the infusion of a 20 % albumin solution (which is costly and rarely available), at the dose of 1 g/kg repeated on the following days if needed, or of 20 ml/kg of fresh, frozen plasma (there is a risk of AIDS), given slowly over two to four hours, to avoid heart failure (concomitant administration of a diuretic is occasionally necessary). Large molecules of the Plasmion®, Dextran® or Rheomacrodex® type may also be infused, at the dose of 20 ml/kg.

The infusion period should be followed by cautious rehydration over a 48-hour period, with 100 ml/kg of a 5 % glucose solution, and soon thereafter, by oral nutritional rehabilitation.

The decision to resort to infusion should be carefully thought out and only taken when oral rehydration is not feasible.

Oral rehydration is preferable for four reasons. The intestinal cells adjust their absorption of water and electrolytes to the body's needs, whereas infusion imposes them according to criteria which may be erroneous. It is often difficult to set up a line, owing to swelling, veins that break, etc. Venous entry is an open door to infection. Last, the child must be kept still, which is traumatic for both the child and the mother.

ANAEMIA

Anaemia is very often observed : often it is qualitatively and quantitatively severe, and surprisingly well tolerated, because it is long-standing. The aetiology is sometimes difficult to establish. Different forms of anaemia may be encountered, including hypochromic anaemia, hypoferric or iron-deficiency anaemia, anaemia of nutritional or parasitic origin (ancylostomiasis, massive ascariasis), macrocytic anaemia caused by folate and/or vitamin E deficiency and last, haemolytic anaemia, either parasite-induced (malaria) or genotypic (drepanocytosis, thalassaemia, G6PD deficiency).

It seems preferable to avoid transfusing children except in case of severe anaemia (haemoglobin < 4 g/100 ml) or signs of hypoxia. Torun recommends the use of 10 ml/kg of whole blood in marasmic children, whereas corpuscle concentrates should be preferred at the dose of 6 ml/kg in kwashiorkor (2). The transfusion should be performed slowly, over two to three hours, to avoid overtiring the heart.

When the anaemia is long-standing and well tolerated, it is best to treat the cause or causes (parasitic disease, for instance) and to provide iron and possibly folic acid supplements following treatment of any infections.

HYPOTHERMIA

These children are poïkilothermic, which means that their body temperature is variable ; they may be cold even in a tropical climate. Rectal temperatures of less than 35°C are often reported in

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(2) Torun B, Viteri FE. Protein-energy malnutrition. In : SHILS Maurice E. (Ed.). Modern nutrition in health and disease. Philadelphia, Lea and Febiger, 1988 ; Chapter 42 : 746-773.

Jamaica and Uganda ; this is more frequent in marasmus, and especially at night. It may be linked with an infectious condition.

These children should be covered well and dried carefully when washed ; contact with the mother's skin and body heat is recommended during the night. The heat of a lamp may be valuable, but one must make sure not to overheat the child. It is advisable to keep these children half naked at a room temperature of 30 to 33°C, and to feed them frequently ; this enables them to achieve self-regulation of their body temperature.

HYPOGLYCAEMIA

This condition, more commonly seen in marasmus, is often symptom-free but occasionally lethal. It is to be feared at the start of rehabilitation ; for this reason children should be fed small meals frequently, throughout the day and night (this avoids early-morning hypoglycaemia).

Severe hypoglycaemia, evidenced by lethargy, absence of reflexes, contractions or convulsions, often goes along with hypothermia. It may be treated by 1 ml/kg of 50 % glucose solution injected intravenously or in a feeding tube, followed by the oral administration of 25 to 50 ml of 5 % glucose every two hours for 24 hours.

CARDIAC INSUFFICIENCY

Cardiac insufficiency generally develops in cases of kwashiorkor involving skin signs. It is of the overall heart failure type (beware of children who cough after eating). It is compounded by anaemia and hypothyroidism, and is the cause of many deaths.

Severely malnourished children tend to accumulate sodium. Wharton has shown that diets providing large amounts of sodium during post-kwashiorkor rehabilitation induce decompensation in the heart. In this case, diuretics of the Lasilix® type (1 to 2 mg/kg/d) must sometimes be resorted to.

INFECTIONS

Protein energy malnutrition and infections are synergetic : malnutrition fosters infections, and infections generate malnutrition.

Infections are often difficult to detect in malnourished children, for two reasons. The first is that symptoms are less visible : fever, tachycardia, feelings of discomfort are diminished and sometimes absent. The only consistent signs are anorexia, lack of weight gain and possibly weight loss in a child who had begun to gain weight. The second reason is that immunodeficiency may cause normally non-pathogenic micro-organisms to become pathogenic in a malnourished child.

Measles

Cases of measles are more serious, last longer and more frequently cause giant-cell lung ailments with a poor prognosis ; viraemia and excretion of the virus last longer, sensitivity to other infections, normally enhanced by measles, is further increased. Malnutrition may have been precipitated by the measles itself or by its different complications (either intestinal with prolonged diarrhoea, respiratory, neurological, etc.) which

cause protein losses, increased catabolism and intake and uptake-related nutritional deficiencies.

Its interaction with vitamin A deficiency should be kept in mind : malnutrition induces vitamin A deficiency, which in turn causes eye damage and makes cases of measles more severe. Vitamin A supplementation should be undertaken in measles epidemics : in a Tanzanian trial it was shown to reduce mortality.

Tuberculosis and measles are particularly severe in malnourished individuals, since cell-mediated immunity is involved in both, and is severely depressed in protein energy malnutrition.

AIDS

Testing for anti-HIV antibodies should be done whenever feasible. Otherwise, diagnosis is purely clinical, which is difficult since severe malnutrition is one of the criteria defined by WHO for exclusion from clinical diagnosis of AIDS.

Marasmus seems to develop at an earlier age in HIV-seropositive children ; infants under age 6 months with a marasmic condition should be seriously suspected of HIV infection. Excler (3) found that 18 (45 %) of the 40 2 to 29-month-old children hospitalized for acute malnutrition in Bujumbura (Burundi) were HIV-positive ; 83 % of these had seropositive mothers (transmission was vertical), whereas transfusions accounted for the other contaminations (17 %). There did not seem to be any gender-linked or anthropometric differences between children in the seropositive group and those who were HIV-seronegative, nor did their history of diarrhoea or fever differ. Conversely, these children did have a more complicated clinical history (at least 9 clinical signs) including hepatomegaly, adenopathy, buccal thrush, dyspnoea and skin diseases. Apparently they responded very poorly to hyperprotein-energy treatments (7 of the 18 children left the hospital with stagnating weight). Excler concludes that in malnourished children, the combination of hepatomegaly, adenopathies, infectious skin disease and buccal thrush, along with non-response to a protein-energy-high diet is suggestive of HIV infection.

HIV infection seriously aggravates the course of malnutrition and therefore raises a new public health problem : there is a 63.6 % death rate for seropositive patients over a 12-month period, versus 10.4 % for seronegatives, in a survey conducted at the nutrition centre attached to the Institut National de Santé Publique in Abidjan (4).

Since the seropositivity rate seems to be much higher in malnourished children living in countries with a high prevalence, nutritional rehabilitation centres in those countries constitute excellent watchposts for AIDS, particularly since the identification of these

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(3) Excler JL et al. Malnutrition et infection à HIV chez l'enfant en milieu hospitalier au Burundi. Pédiatrie, 1987 ; 42 : 715-718.
(4) Rey JL. et al. L'infection VIH dans un centre de récupération nutritionnelle à Abidjan (Côte d'Ivoire). Revue pédiatrie, 1990 ; 27 (8).

children leads to the detection of mothers, who are the key target group (women of child-bearing age).

When treating severely malnourished children the rules governing asepsis must be applied strictly, both to avoid contamination of the personnel if the children are seropositive, and to protect the children, who are immunocompromised and extremely sensitive to contamination.

Malaria

Malaria has a damaging effect on the nutritional status of the host : fever, loss of appetite and anaemia reverse the protein balance, thus frequently causing weight loss and occasionally inducing protein energy malnutrition. Paradoxically, malaria does not seem to be worsened by malnutrition : it is apparently less severe and lethal in cases of marasmus or kwashiorkor, since iron deficiency - like the absence of para-aminobenzoic acid, necessary for its growth, and a vitamin E deficiency - seems to limit the parasite's reproductive ability.

Antimalarial treatment should be immediately initiated in regions where malaria is endemic, unless a laboratory can demonstrate the absence of Plasmodium in the blood.

Other protozoa-caused parasitic diseases are worsened by malnutrition. These include visceral leishmaniasis, toxoplasmosis and pneumocystosis.

Tuberculosis

Tuberculosis, either pulmonary or extrapulmonary, may be of the utmost gravity ; diagnosis is difficult, owing to tubercular anergy (the tuberculin test is negative). A chest x-ray may be useful. Acid-fast bacilli may be recovered by gastric tubage or laryngeal aspiration. Sometimes the discovery of a retinal nodule discloses the existence of tuberculosis (about 50 % of cases of miliary tuberculosis have retinal tubercles) : for this reason, a fundus of the eye may be of diagnostic value. Clinical, radiological and bacteriological (sputum) examination of people in contact with the child is often worth while.

In any case, tuberculosis should always be suspected when no significant weight gain occurs despite correct renutrition over a one-month period, in case of protracted lung disease, unexplained fever, lymph nodes resisting antibiotherapy or proximity of a case of tuberculosis. It may occasionally be confused with AIDS. If there is any real suspicion, trial treatment may be considered.

Other infections

Broncho-pulmonary infections

Malnutrition is considered a key risk factor in the development of lung disease and a rise in the prevalence of viral pulmonary infections seems to go hand in hand with increasingly serious malnutrition. Like any infection in a malnourished child, pneumonia is difficult to diagnose, since x-rays show inflammation only.

Urinary infections

Apyretic, pyuria-free urinary track infections are present in an estimated 10 % of malnourished children (boys and girls), at the least.

ENT infections

Chronic otitis of the middle ear is extremely frequent in cases of protein energy malnutrition (PEM). There is no visible, acute inflammatory reaction at the tympanic membrane level, however : the tympanic membrane is unusually thick and grey or pinkish, and no longer reflects light, or only slightly. Severely malnourished children rarely have a normal tympanum.

Infections of the mouth

These include thrush, in the form of a whitish patch (possibly preventing the child from eating, and requiring insertion of a feeding tube), dental pyorrhoea and herpes. Candidiasis-type infections may be treated by nystamine, using either a topical or a systemic route.

Skin infections

Skin disorders are sources of local superinfection, especially in kwashiorkor. Use of topical antibiotics does not seem advisable ; daily application of 1 % permanganate for 10 to 15 minutes is relatively effective ; zinc oxide ointments or tulle gras relieve pain. Scabies is frequent in malnourished children.

Acute diarrhoea of infectious origin

A distinction should be made between diarrhoea, either acute or chronic, of infectious origin (caused by parasitic, bacterial or viral disease) and persistent diarrhoea induced by nutritional problems.

Of parasitic origin

All of the main intestinal helminthiases (ascaridiasis, ancylostomiasis, bilharziasis) may be seen in conjunction with PEM. Malnourished individuals tend to have higher parasite burdens, and the diminished protein uptake capacity induced by the impairment of the anatomic and functional integrity of the intestinal mucosa accounts for the protein deficit.

Anti-parasite treatment depends on the prevalence of different intestinal parasites in the area and on laboratory findings for stools. Mebendazole (10 mg twice a day for three days) is the choice anthelminthic treatment. Giardia lamblia, very frequently encountered in severe malnutrition and chronic diarrhoea, is difficult to isolate and requires special attention.

Of bacterial origin

There is a major imbalance in the endogenous bacterial flora. The proximal small intestine and the stomach seem to lose their relative sterility during PEM. Bacteria, especially those that are strict or facultative anaerobes, proliferate, as do certain yeasts. The swollen abdomen that is so typical of malnutrition is caused by the fermentation gases produced by these micro-organisms. This proliferation results in a blind gut syndrome and chronic diarrhoea. Bloody stools are indicative of infection with Salmonella, Shigella or, occasionally, E. coli.

Of viral origin

Rotavirus-caused diarrhoea is extremely frequent and induces lactose intolerance. In Senegal, J.P. Beau and his coworkers have demonstrated the value of using fermented milk in addition to oral rehydration when feeding malnourished children with acute diarrhoea and lactose intolerance (5).

(5) Beau JP et al. Management of malnourished children with acute diarrhoea and sugar intolerance. Trop-Ped-J, 1990 ; 36 : 86-89.

Septicaemia

Septicaemia originating in the intestinal or respiratory system, often associated with hypothermia or hypoglycaemia, is a frequent cause of sudden death.

Chronic diarrhoea

For many years, lactose intolerance was viewed as a major factor in malnutrition. Protein and iron deficiencies are conducive to atrophy of the intestinal villosities, and reduction of the amount of digestive enzymes secreted. If too much food enters the system suddenly, the body is unable to absorb it and diarrhoea ensues, producing rejection of food : whence the importance of giving small amounts of food, but at short intervals.

Some children have what is known as persistent diarrhoea, even when this rule is respected. It is acute at first, and persists for more than two weeks, and seems to play a major role in both malnutrition and diarrhoea-related mortality. An estimated 35 % of deaths linked to diarrhoea are caused by a bout of persistent diarrhoea, although bouts of persistent diarrhoea only represent 3 to 20 % of all cases of diarrhoea.

It has been shown that milk may aggravate diarrhoea, when intestinal lactase activity is deficient ; this is unfortunate since it is a particularly valuable source of proteins, galactose, minerals, vitamins, etc.

The problem of lactose intolerance, defined by watery stools with an acid pH (< 5.5) and the presence of reducing sugars in the stools, attested by the clinitest, has been solved by using fermented milk in yoghurt form. This has three advantages :

- lactose is more easily digested in the form of yoghurt than in milk form, in children with intestinal lactase deficiency ;

- the milk proteins are modified during the yoghurt-making process ;

- yoghurt is easy to prepare in clinics and even in homes.

Immunization

For its extended programme for immunization, WHO does not list malnutrition as a contra-indication for vaccination, and it therefore seems preferable to begin this programme before the onset of malnutrition, which is to say before age one year. The immunodepressive effects of malnutrition on the body's defence mechanisms are contributory and aggravating factors in the risk of bacterial, viral or parasite-linked infection. Malnutrition is a major cause of severe complications and death in the course of infection, whence the importance of prevention through immunization.

Recent immunological findings show that children may acquire immunity at a very early age, starting at the second or third month of life. There is no reason to delay vaccinations beyond that age, especially for children living in disadvantaged countries, where the risk of developing malnutrition during the weaning period is enormous.

The immunization of malnourished children is imperative. Measles vaccination seems to yield satisfactory results, except perhaps in cases of severe swelling. Adverse reactions to the vaccines are neither more frequent nor more serious in malnourished individuals.

Malnutrition does not seem to have any negative effect on vaccination against diphtheria, tetanus or polio : only the oral polio vaccine is disadvised.

The cell-mediated immunity required for the development of a response to the BCG is impaired in severe malnutrition. The intradermal tuberculin test cannot be used to test the effectiveness of the vaccine, since depression of this type of immunity may disturb retarded hypersensitivity tests as well. Conversely, other methods for exploring cell-mediated immunity (such as blast transformation) may be positive despite a negative tuberculin test ; furthermore, an initially negative tuberculin test may later become positive when nutritional status improves.

Response to treatment

Antibiotherapy should not be administered automatically, but should depend on the infected site and the type of germs isolated. While tuberculosis, otitis media or a urinary infection may occasionally account for stagnating weight during rehabilitation, several other aetiologies are plausible, including an undiagnosed infection, qualitatively or quantitatively inadequate nutriture, a deficit in a specific nutrient, a chronic intercurrent pathology and inadequate emotional or interpersonal relations.

Some researchers suggest the blind use of broad-spectrum antibiotics such as penicillin/gentamycin, for these malnourished children who do not recuperate properly and in whom no specific infection can be found.

Pharmacokinetics are disturbed in malnourished children for a number of reasons, including delayed and reduced uptake of medication, decreased amount of carrier proteins, fluctuation in the distribution volume, impaired liver functioning and reduced renal elimination capacity.

Several studies seem to indicate that the drugs taken accumulate in the body, entailing increased risks of toxicity, especially during the resuscitation phase. It seems reasonable, at present, to use standard treatment doses and to avoid any drug overload, especially during resuscitation. Drugs and antibiotics should be given only when absolutely necessary. Analgesics and antipyretics, and aspirin in particular, should be dispensed with caution. These medications should be given at lower doses than those used for healthy children.

PROGNOSIS

Short-term

The mortality rate for severe malnutrition remains high, sometimes as high as 40 %, the immediate cause of death often being infection. However, this figure may drop to 10 % or lower when children receive appropriate treatment and follow-up. The prognosis is worse for children with fluid and electrolytic disorders or infections.

Some clinical and biological signs are particularly serious, such as the disappearance of the fatty ball of Bichat in marasmus, advanced skin and mucosal signs, severe hepatomegaly associated with petechiae, a mild rise in bilirubin and a low prothrombin concentration, severe hypothermia and hypoglycaemia or waning consciousness along with a high transaminase (SGOT) level.

Unfortunately, relapses occur frequently, and are often more serious and more difficult to treat than the first bout.

Long-term

The consequences of malnutrition depend on its duration and severity, and on the child's age.

Some children remain puny, with an abnormal body composition and relatively large amounts of fatty tissue in comparison with incompletely reconstituted muscles. They never attain the theoretically normal height for age, and delayed puberty compensates for this growth retardation.

The worst sequelae are probably those affecting psychological and mental development : PEM is associated with retarded psychomotor development and lowered performance on psychology tests. Antisocial behaviour may be observed. However, the long-term consequences depend on the environment encountered by these children subsequently to treatment of the acute episode. Studies of refugee children adopted by families with a good socioeconomic status show that they recover a totally satisfactory level of growth and psychomotor development. This is food for thought on case management and policy definition.

Marasmus is a form of malnutrition tending toward wasting, whereas kwashiorkor is characterized by oedema, damage to the skin, hair and nails, and psychological disorders.

Dehydration and fluid and electrolyte disorders are indicative of a poor prognosis. A child with oedema may nevertheless be dehydrated. Rehydration should be gradual, and infusion avoided whenever possible.

Transfusions should only be given in case of severe, poorly tolerated anaemia.

Watch out for hypothermia, hypoglycaemia, heart failure.

Infection and malnutrition are mutually potentializing. Measles, AIDS, tuberculosis, urinary infections and otitis are particularly dangerous.

Give yoghurt in case of persistent diarrhoea.

Malnourished children should be immunized, especially against measles.

Beware of overmedication.

ANTHROPOMETRIC APPROACH

Anthropometrics is an important tool in treating severely malnourished children, since it yields simple data which constitute measurable, and hence objective, criteria for evaluation. The focus here is the individual child rather than a group. Correct interpretation of individual anthropometric measurements requires that they be integrated in a comprehensive analysis including other clinical, biological, nutrition-related, social, psychological and environmental data.

REVIEW OF THE MAIN ANTHROPOMETRIC TOOLS

An individual's nutritional status is the outcome of the balance between dietary intake of energy and nutrients (consumption) on the one hand, and the physiological nutritional requirements and extra expenditures entailed by physical activity or disease, on the other hand (cf. figure 6).

Use of anthropometric data entails a number of steps : measurement-taking, calculation of indices and analysis of the indicators.

DATA COLLECTION

Measurements are raw data on children. A number of different possible anthropometric measurements, such as weight, height, arm circumference, skinfolds and head circumference, may be taken. This is an essential phase : since all subsequent calculations are based on these measurements, any error committed at this level results in the erroneous interpretation of the child's health status. Measurements must be accurate, reliable and reproducible. For this, they must be standardized, normalized, and the instruments used controlled at regular intervals (cf. Children in the Tropics, n° 181/182). Some basic notions are reviewed below.

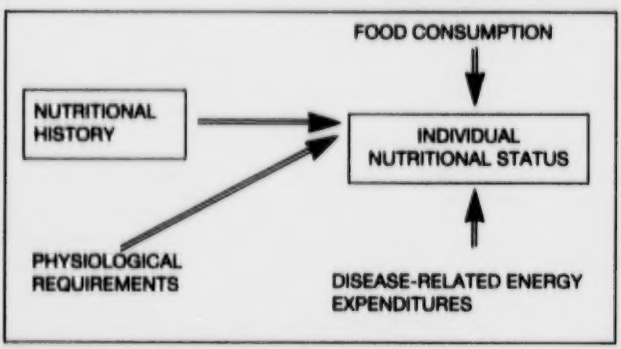

Figure 6 : The main anthropometric tools : a reminder.
Source : Chaulieu M, Masse-Raimbault AM. Nutritional status : the interpretation of indicators. Children in the Tropics 1989, N° 181/182.

Weight

Monitoring requires that a child always be weighed under the same conditions : undressed, preferably at the same time of day, on a tared scale. The weight should not be read until the beam of the scale is steadied. Otherwise, differences of up to 100 to 200 g may occur, thus inducing serious errors in interpretation.

Height

When the child is measured lying down, beware of bent knees, pointed feet, a head that does not touch the top board. When measured standing up, the heels, buttocks and head must touch the vertical plane.

Age

It is sometimes difficult to ascertain the child's age. The calendar of local events - farming cycle, traditional celebrations, etc. - should be used to obtain indications.

Arm circumference

The rules for measuring arm circumference should be scrupulously respected : measurement in centimetres halfway between the acromion (at the shoulder) and the olecranon (at the elbow), using a measuring tape placed on the untautened skin, with the arm hanging loose parallel to the body.

Head circumference

The head circumference is often difficult to measure because the correct position for the tape measure must be found. Several measurements should be made.

Triceps skinfold

The triceps skinfold is measured using calipers of the Harpenden type : determine the point halfway between the acromion and the olecranon, when the arm is bent so that the forearm forms a 90° angle. The arm is then straightened for the measurement itself. The skinfold is measured at the arch of the triceps. It assesses the degree of depletion of subcutaneous fatty reserves.

The arm circumference and triceps skinfold are used for the calculation of the arm muscle circumference and the arm muscle area, used to appraise the lean mass of the body.

A trained technician is required for this type of measurement ; changes in skinfold thickness occur slowly, and cannot be used to assess short-term improvement of nutritional status at the individual level ; furthermore, measurement of skinfolds is not utilizable in case of oedema or when the skin is extremely flaccid.

Calculation of indices

A weight of 5 kg is a meaningless fact. To be interpreted, it must be related to another measurement such as age or height, to form an index. Indices are combinations of measurements, such as weight for age, height for age, weight for height, arm circumference for head circumference.

ANALYSIS OF FINDINGS

Indicators are constructed using a special value, known as the cut-off point for an index. They locate the child with respect to a group. WHO recommends the use of the data issued by the National Centre for Health Statistics (NCHS) as references. Certain authors suggest using local charts, since it has been demonstrated that children under age 5 grow differently in different surroundings, and that their anthropometric data, charted on growth curves, are clearly not the same. Although we acknowledge the limits of the international curves, still, we find it preferable to use an identical reference basis for children everywhere.

For indices combining weight, height and age for a sample of healthy children, the median should not be considered an objective to be achieved for each child taken individually. These charts should simply be used to determine the child's progress and to assess the homogeneity of his or her growth curve.

There are many classifications based on anthropometric data, the role of which is to identify subjects requiring nutritional or health

intervention and to situate the extent of their malnutrition - at best, to detect children running a high risk of death. Each of these classifications has its advantages and its disadvantages : only a few are described below.

Gomez' classification

Gomez' classification is based on weight retardation. It locates the child on the basis of his or her weight in comparison with a normal child of the same age. In this system, the "normal" reference child is in the 50th centile of the Boston standards. The cut-off values were set during a study of risk of death based on weight for age at admission to a hospital unit. This classification therefore has a prognostic value for hospitalized children.

$$\text{Weight for age (\%)} = \frac{\text{weight of the child}}{\text{weight of a normal child of same age}} \times 100$$

Between 90 and 110 % : normal nutritional status
Between 75 and 89 % : 1st degree, mild malnutrition
Between 60 and 74 % : 2nd degree, moderate malnutrition
Under 60 % : 3rd degree, severe malnutrition

Arm circumference

The above classification does not consider the fact that the earlier the occurrence of malnutrition, the greater is the risk of death (a W/A ratio < 60 % does not have the same meaning in a 6 month-old and a 2 year-old) ; and what is important for us is to take action for children who run the greatest risk of death. Arm circumference seems to be the most appropriate indicator for the estimation of the risk of death.

It is a fact that arm circumference yields a relatively reliable estimation of the body's muscle mass, the reduction of which is one of the most striking mechanisms by which the body adjusts to inadequate energy intakes. The child's weight is conditioned more by the total amount of body water, which, as we know, tends to increase in malnutrition. Arm circumference, which is a simple anthropometric measurement, cannot be used before the age of one year ; between ages one and five years, it hardly varies.

An arm circumference exceeding 13.5 cm is a sign of a satisfactory nutritional status, between 12.5 and 13.5 cm it indicates mild-moderate malnutrition and below 12.5 cm, severe malnutrition.

At the present time, this index is probably the most rapid, most effective way of detecting children with a high risk of death. However, there is a real problem in determining the cut-off figures for intervention. The figure of 12.5 cm seems to have been chosen to coincide with Gomez' classification, which was extremely popular many years ago. It is quite possible that regional modifications in the cut-off values are necessary. Briend recommends the use of lower cut-offs - 11 cm, for instance - for admission to treatment centres.

Waterlow's classification (1972)

When a child's age is known, measurement of weight enables almost instant monitoring of growth ; other measurements such as height assess the effect of nutritional status on long-term growth.

Waterlow's classification defines two groups for protein energy malnutrition :

- malnutrition with retarded growth, in which a drop in the height/age ratio points to a chronic condition - shortness, or stunting ;

- malnutrition with a low weight for a normal height, in which the weight for height ratio is indicative of an acute condition - rapid weight loss, or wasting.

Faltering weight for age may be linked with either of the above two situations, and reflects an overall condition. Low weight, in this classification, is independent of age. As a rule these different problems are inter-related : these children already have chronic malnutrition and a bout of infection causes them to break down and enter a process of acute malnutrition.

This combination of indicators makes it possible to label and classify individuals with reference to two poles : children with insufficient but well-proportioned growth and those with a normal height, but who are wasted (cf. table 2).

Table 2
Interpretation of indicators

Weight/Height (%) = $\frac{\text{Weight of the child}}{\text{Weight of a normal child at same height}} \times 100$	
Height/Age (%) = $\frac{\text{Height of the child}}{\text{Height of a normal child at same age}} \times 100$	

Nutritional status	Stunting (% of height/age)	Wasting (% of weight/height)
Normal	> 95	> 90
Mildly impaired	87.5 - 95	80 - 90
Moderately impaired	80 - 87.5	70 - 80
Severely impaired	< 80	< 70

Indices expressed as Z scores, or standard deviations, may be used in this classification. Use of standard deviations is consistent with a statistical approach : in any reference group, the distribution of a variable is known to follow a Gaussian curve, which is the graph form of what is called the law of probabilities. It is described by its mean, which corresponds to the median, or fiftieth centile, and its standard deviation, which is calculated mathematically. The interval located between the mean plus and minus two standard deviations contains 95.4 % of all individuals, whereas 4.6 % of the population is located outside of that range. Malnutrition is defined by WHO as a weight for age below the median minus two standard deviations of the NCHS reference population. In the reference

population, 2.3 % of individuals are located below this cut-off point (cf. table 3).

Table 3
Waterlow's classification

W/H / H/A	> m - 2 SD	< m - 2 SD
> m - 2 SD	Normal	Stunted
< m - 2 SD	Wasted	Wasted and stunted

m = mean
SD = standard deviation

This classification separates malnourished children into those with acute malnutrition, chronic malnutrition and acute malnutrition in pre-existing chronic malnutrition.

Practically speaking, it is important to be familiar with these indicators and their advantages and shortcomings, so as to view the findings of epidemiological studies with a critical eye. Figures may receive widely varying interpretations, depending on the indicator and cut-off values used.

ANTHROPOMETRICS AND NUTRITIONAL REHABILITATION

DETECTION AND MANAGEMENT OF CHILDREN

In practice, anthropometrics is used to identify children at great risk of death, for evaluating the seriousness of their condition and assessing specific aspects of their recovery during rehabilitation.

When attempting to detect children requiring intervention, several questions should be asked :

- which anthropometric indicator reflects children's nutritional status most reliably?

- which reference discriminates best between malnourished and non-malnourished children?

For the time being, there is no definite answer to the first question, which is still the object of controversy. There is probably no single answer : perhaps it would be a combination of indicators along with clinical and biological findings. In practice, what is sought is a simple technique for detecting children at great risk of death. Arm circumference seems to meet that definition, and is used by a great many teams world-wide. The detection of severely malnourished children generally is not problematic, since the diagnosis is, unfortunately, often all too evident. The search for the most specific, most sensitive indicator mostly concerns under-fed children requiring attention from a food supplementation programme ; a finer assessment of nutritional status is then required.

Choice of the cut-off value, which directly affects the criteria on which admission to a nutritional rehabilitation programme is based, depends on the human and logistic resources available, the number of children who may be cared for, the cost and the

efficiency of the programme implemented ; it also depends on the risk involved in the lack of intervention for each degree of malnutrition. Briend recommends the use of low cut-off values, which make the indices specific but not very sensitive (6).

ASSESSMENT OF THE SEVERITY OF MALNUTRITION

Once a child has been identified as malnourished, the degree of severity of the condition must be assessed. The conclusions are very different depending on the anthropometric indicator used and the cut-off value selected.

Different indicators include varying numbers of children in the severe malnutrition category. Choice of an indicator in view of the selection of children who will benefit from a nutritional intervention is no trifling matter, then. Arm circumference is apparently the most sensitive, but probably not the most specific indicator. When malnutrition is detected in a child, it is essential to combine measurement of arm circumference with calculation of the W/H index, to assess the extent of malnutrition, when a costly intervention restricted to a limited number of children is visualized. Cut-offs of 110 mm for arm circumference and 70 % for weight/height index are often used as admission criteria for nutritional rehabilitation centres.

The limits of anthropometrics as a tool are such that irrespective of the type of indicator used, the decision to treat a child cannot be based on the cut-off value only, but must consider a broad range of clinical, anthropometric, biological, psychological and socioeconomic arguments.

Two other facts are valuable in assessing the degree of malnutrition in a candidate for care : birth weight and length of gestation.

Birth weight

A child's birth weight yields information on his or her nutritional history, since this weight is affected by many factors, including length of gestation as well as the mother's health status (her height, weight at the start of pregnancy, age, parity, interbirth interval and educational level).

Birth weight is a means of determining the prognosis for the infant's development, growth and survival. A number of studies have shown that neonates with a birth weight under 2,500 g have higher morbidity and mortality rates and run a greater risk of retaining physical and psychomotor developmental sequelae.

Birth weight is a mark of the inter-relatedness of mother and child, and another reason for taking this dyad into account in rehabilitation. The child's nutritional history conditions his or her status at the treatment stage.

Gestational age

It is important to determine whether low birth weight is the result of prematurity (pregnancy lasting less than 37 weeks) or of intrauterine growth retardation (IUGR in an at-term infant). While pre-

(6) Briend A, Genaille V. Détection et prise en charge des cas de malnutrition en populations réfugiées. Cahiers d'Etudes et de Recherches Francophones. Santé et Développement, 1992 ; 2, (6) : 369-376.

matures catch up on weight and length within months of birth, the same is not true of children with IUGR.

Furthermore, there are two types of IUGR. The rates of intrauterine growth, of length and weight do not peak at the same points in pregnancy : length growth is greatest toward the 20th week, while weight peaks toward the 34th week. The child will have a low length and/or weight depending on the moment when the occurrence causing intrauterine growth retardation intervenes.

ASSESSMENT OF THE CHILD'S RECOVERY

Neither arm circumference nor triceps skinfold are sufficiently sensitive for the assessment of the changes that occur in the course of recovery. Weight alone may guide our strategy. In the case of a child with kwashiorkor, however, there is a loss of weight during the first few days. The evolution can then only be assessed on the basis of a combination of anthropometric, clinical, biological, nutritional and behavioural data.

What counts most is not the quantity of figures, but their quality and reliability. The frequency of weighings depends on the personnel available ; unreliable measurements are useless, if not dangerous. During the resuscitation phase, the child may be weighed daily if there are enough sufficiently motivated workers to do so. Two weighings a week suffice if resources are limited. This should be a time for establishing special contact with the child, and should not be traumatic.

During the recovery phase, once-weekly weighings are sufficient. Some teams collect a large number of anthropometric measurements. It seems preferable to choose a method for monitoring, and to apply it correctly.

Computerized monitoring

Micro-computers are often available for field work, at present. Whereas their use in anthropometrics is mostly confined to epidemiological studies (of the nutritional status of population groups), they definitely are useful in nutritional rehabilitation centres.

At the individual level, they enable the rapid, accurate calculation of anthropometric indices such as weight for age, weight for height and height for age, and comparison with international standards. Several programmes for calculating anthropometric indicators directly are now on the market ; one of these is ANTHRO (used by WHO and the Atlanta CDC). During epidemiological studies, this programme can analyse data for one child after another. Computerization is then a tool for anthropometric monitoring.

At the nutritional rehabilitation centre, computers are used for the rapid analysis of information from a number of areas. It then becomes an instrument for the evaluation of the centre's activities. Programmes such as version 5 of EPI-INFO, recommended for calculating and analysing anthropometric indicators, are also valuable for the development of relevant questionnaires.

There are disadvantages, such as their high purchasing price and the need for maintenance and personnel training. Use of micro-

computers should not entail too much extra work ; it is justified, provided there is a clear view of what is expected of them.

Anthropometrics is an extremely valuable tool once its limits are acknowledged and accepted, provided measurements are accurately recorded and the findings correlated with all other available clinical and biological information.

Severely malnourished children may be detected using measurement of arm circumference.

The initial anthropometric assessment may include :

- birth weight
- length of gestation
- child's age
- sex
- weight when first seen
- height or length when first seen
- arm circumference when first seen
- head circumference when first seen.

Supervision of nutritional rehabilitation includes :

- resuscitation phase : weighing daily or 2 to 3 times a week ;
- refeeding phase : weighing once a week, height measurement once a month ;
- charting of the weight curve.

BIOLOGICAL APPROACH

BIOLOGICAL CONSEQUENCES

Biological disturbances vary with the extent of the protein and energy deficit, but also with the type of accompanying vitamin and mineral deficiencies. While only minimal biological disturbances are found in pure marasmus (with normal or slightly low blood proteins, a slight drop in albuminaemia, possible but usually moderate anaemia except in conjunction with other deficiencies, normal blood ionogramme or tending toward acidosis, low blood sugar, copper, hydroxyproline and iron levels), disturbances are much greater in kwashiorkor.

Serum proteins

Protein assay is often used to assess nutritional status : in this case, only the visceral protein sector is considered, as reflecting overall reserves, although it only represents 15 % of all proteins.

Proteins

The blood protein level is normal or slightly lowered in children with marasmus, whereas it is very disturbed in kwashiorkor, somewhere around 40 g/l in contrast to reference figures between 55 and 78 g/l. This is not a good biochemical indicator of protein energy malnutrition, since it is too dependent on other factors such as hyperglobulinaemia.

Albumin

Albuminaemia may be slightly lowered in marasmus, whereas it plunges in kwashiorkor, with figures around 14 g/l. Some teams have actually recorded figures as low as 8 g/l (references for children are between 40 and 58 g/l). Serum albumin concentration is often viewed as a good indicator of the body's protein reserves, but it is not very sensitive as a marker of recent or moderate undernourishment. Because albumin has a relatively long half-life - 18 to 20 days - hypoalbuminaemia always points to severe, long-standing malnutrition. In addition, it declines in case of infection.

Amino acids

The deficit mostly affects the essential amino acids, and among these, the branched-chain amino acids (valine, leucine, isoleucine). The concentration of non-essential amino acids is generally normal or high ; this results in a reversed non-essential/essential amino acid ratio, which is normally below 2.

Globulins

Concentrations of alpha 2 and beta-globulin, as well as of ceruloplasmin (an alpha 2 globulin), are low.

Gamma globulins are not affected by nutritional status and are high when infection is present. The albumin/globulin ratio is always under 1.

Transferrin

The transferrin (siderophilin) concentration is often low, and declines more rapidly than the albumin concentration, since it has a shorter half-life : about 8 days. It is an earlier indicator of protein malnutrition. Conversely, the normal values are very scattered and vary with sex, age, presence of infection and the body's iron reserves. It is unfortunately not a sufficiently sensitive indicator for use in monitoring renutrition. Normal values are between 2 and 3.5 g/l.

Retinol-binding protein and thyroxin-binding pre-albumin

These two proteins, retinol-binding protein (RBP) and thyroxin-binding pre-albumin (TBPA), form a complex, the variations of which in the blood are highly sensitive to protein-energy deficiencies. Both have a very short half-life : 2 days for TBPA and 12 hours for RBP. TBPA seems to be the most sensitive and most specific index for protein energy malnutrition. Normal values are 0.10 to 0.40 g/l for TBPA and an average of 0.05 to 0.07 g/l for RBP. The results of micro-assay of capillary blood seem to be comparable to those found by venous puncture, making that method quite valuable. Unfortunately, concentrations of these two proteins are disturbed by infection, inflammation and hepatic or renal insufficiency.

Urea and creatinine

The blood and urinary urea concentrations are low, as is the 24-hour urinary excretion of creatinine, both of which are indications of the decreased mass of muscle. Creatinine, formed from the creatine in muscles, is eliminated by the kidney in a constant flow if the diet does not contain any creatinine (mostly found in meat). A low excretion figure therefore points to a small muscle mass.

Fluid and electrolyte balance

Natraemia

Natraemia may be normal but is often low, around 130 mEq/l, and the prognosis is then very bad ; the intracellular sodium reserves are increased, owing to impaired permeability of the cell membranes (the sodium and potassium pumps are less active), irrespective of the type of malnutrition. Because of these membrane disturbances, it is useless and even dangerous to rely on the serum sodium concentrations, which absolutely do not reflect the body's reserves.

Kaliaemia

Kaliaemia is low (around 2.5 mmol/l) or very low, with an extremely low total body potassium concentration. This does not reflect the potassium reserves properly, since these are always greater than shown in the blood ionogramme.

Osmolarity

Blood osmolarity is diminished in all three body compartments. There is an increase in total water (expressed as a percentage of body weight, total water rises from the normal figure of 60 % to 75 % or more in marasmus, and 80 % in kwashiorkor). Furthermore, there is an abnormal distribution of the fluid between the compartments, with inflation of the extracellular fluid sector. These disturbances are aggravated by the increased clearance of free water and the decreased renal ability to concentrate urine. Hypoprotidaemia causes the intravascular oncotic pressure to drop, thus increasing hyperaldosteronism.

Glycaemia

It is normal or low, often fluctuating. The clinical sign of hypoglycaemia is convulsions, only seen in case of severe infection. The prognosis is then very bad, in spite of treatment.

Magnesaemia

The blood magnesium content is lowered variably, and is described as linked to hyper-irritability, with peculiar wrist movements in malnourished children suffering from acute gastroenteritis without hypocalcaemia. The coexistence of potassium and magnesium deficiencies requires that both ions be provided in order to replenish potassium.

Phosphocalcium balance

Blood calcium is often normal, whereas phosphorus depletion is habitual. Hydroxyprolinuria is low, pointing to a slow-down in the synthesis of collagen, and therefore of growth. Skeletal x-ray shows osteoporosis with abnormally thin cortical areas, particularly in the metacarpals.

Trace elements

For many elements, plasma concentration does not reflect the body's reserves : the serum iron concentration may be normal although the body's reserves are depleted ; it may be low in kwashiorkor when reserves are normal, because of impairment of carrier proteins such as transferrin.

Iron

Zinc

Zinc deficiency contributes to loss of appetite by modifying taste, causing behavioural disorders, hypotonicity and indifference.

Copper

Copper deficiency has been evidenced in severe protein energy malnutrition and is responsible for hypochrome anaemia resistant to simple iron replenishment, as well as for severe neutropenia. It does not seem to be due to insufficient copper intake, but is an offshoot of hypoproteinaemia.

Chromium

Chromium deficiency is closely tied to insulin secretion, and seems to be a causal factor in fluctuating glycaemia regulation in these children.

Selenium, manganese and vanadium concentrations are also low. Selenium, in conjunction with vitamin E, is involved in immunitary defence.

Lipid balance

Total and esterified cholesterol levels decline because of lowered fat intake, and impaired transport linked to a deficit in carrier proteins, but also because of a deficit in endogenous hepatic cholesterol. There is an essential fatty acid deficit, and reduced endogenous synthesis of triglycerides.

Hepatic balance

The hepatic balance is disturbed as a result of steatosis, a frequent occurrence in kwashiorkor but exceptional in simple marasmus. Transaminase concentrations are high, whereas concentrations of lipase and amylase, as well as of haemostatic factors, are low.

HORMONAL CONSEQUENCES

Endocrine adjustments cannot be accounted for exclusively by modifications in circulating hormones ; protein energy malnutrition induces changes in the secretion rates and half-life of hormones, but it also modifies cellular responses to stimulation by hormones. There is much research, and differing conclusions, as to the endocrine modifications induced by malnutrition ; this is probably due to differences in investigative methods and assay techniques.

In the case of insulin secretion, the totality of the mechanisms involved in maintaining the blood glucose concentration above a minimum work to preserve the functionality of the brain.

With respect to growth, chronic malnutrition is linked with a reduced somatomedin-C concentration, connected with decreased synthesis and the presence of inhibitors. As a result, there is a

secondary increase in the growth hormone concentration, with a negative feed-back to the pituitary and consequently, decreased synthesis of the growth hormone. In the last analysis, this process side-tracks the substrata normally involved in growth for use by the basal metabolism.

In malnutrition, the high hydrocortisone concentration seems to be the outcome of decreased metabolic clearance, with stress helping to maintain a high hydrocortisone level and to eliminate nyctohemeral variations.

The reduced activity of the thyroid hormones produces decreased thermogenesis and oxygen consumption, which economizes energy. This illustrates the process by which the organism adjusts to its energy deficit.

Retarded puberty, induced by malnutrition, represents an extremely interesting form of adaptation, especially in women, who become capable of reproduction when their body mass is able to cope with pregnancy and lactation. Some authors have shown that the lower limit to be reached before puberty can begin is 30 kg.

IMMUNOLOGICAL CONSEQUENCES

Malnutrition, immunodeficiency and infections all interact to form a truly infernal spiral, ending in death (cf. figure 7).

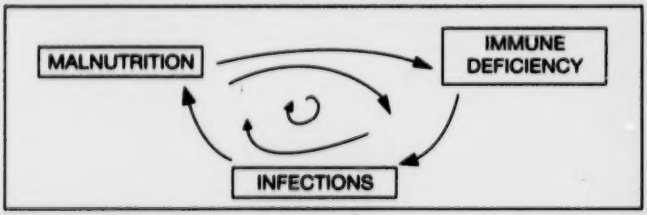

Figure 7 : Interactions.

Effects of protein-energy deficiency on immunity

Lymphoid structures

Insufficient proteins and energy cause the thymus to shrink and eventually to atrophy : this is considered a virtual "nutritional thymectomy". As early as 1845, Simon, who probably did not have the slightest notion of the role played by the thymus in immunity, called it the "barometer of nutrition". It plays a role in T-lymphocyte production. The lymph glands, tonsils and spleen are also affected, along with Peyer's patches, the consequence of which is reduced local antibody production by the intestinal plasmocytes. Foetal malnutrition compromises the development of the lymphoid structures.

Lymphocyte population

The lymphocyte population includes thymo-dependent T lymphocytes, on which cell-mediated immunity is based, and thymo-independent B lymphocytes, involved in humoral immunity.

Cell-mediated immunity

There is a reduction in circulating T lymphocytes. OKT4 (helpers) cells are greatly decreased, whereas the OKT8 (suppressor cells) are only slightly reduced, whence a low helper/suppressor ratio.

Recovery of a normal nutritional status brings this ratio between lymphocyte subgroups back into balance. Retarded hypersensitivity tests such as the tuberculin test are disturbed.

Humoral immunity

There is only a mild disturbance of humoral immunity in protein-energy deficiency, and the rise in immunoglobulin concentrations is connected with the frequency of infections. Only the serum and secretory IgA concentrations drop, and this contributes to the development of digestive and respiratory infections. IgE tend to multiply, because of the high prevalence of intestinal parasites.

The mucosal barriers are damaged, thus facilitating the penetration of pathogens. Similarly, the composition of the intestinal flora is disturbed, thus contributing to the occurrence of diarrhoea.

Effects of trace element deficiencies

Iron

Iron is necessary for the synthesis of DNA ; it is also a co-factor with enzymes in the intracellular destruction of bacteria. Iron depletion increases sensitivity to infection through reduction of the number of roset-forming T lymphocytes, reduced lymphocyte response to mitogens and low lymphokine production. Neutrophils have a diminished bactericidal capacity in iron-deficient individuals. The antibody response and complement system are left intact, on the other hand.

Zinc

Zinc is essential to the development and functioning of the immune system. One thymic hormone, thymulin, requires the presence of zinc for its action on lymphocyte maturation. The chemotaxis of polymorphonuclear cells and their bactericidal activity are reduced.

Copper

Congenital copper deficiency (Menkès' disease) causes many infections through deficient polymorphonuclear functioning, defective lymphocyte reactivity and reduced antibody production.

Selenium

Selenium is an essential component of glutathion peroxidase, an enzyme which destroys the hydrogen peroxide that develops in tissues, and contributes to the formation of active oxygen radicals in bactericidal action. Selenium deficiency, especially when combined with vitamin E deficiency, reduces antibody production.

Other metals involved in immunological defence mechanisms include cobalt, which interacts with vitamin B_{12}, magnesium, nickel and iodine.

Effects of lipid deficiency

Circulating lipids are active in immuno-modulation : any deficit or excess is a disturbing factor. Lipids enter the cell membranes, of lymphocytes in particular, and may modify their fluidity. This may disturb the chemotaxis and bactericidal activity of granulocytes.

Effects of vitamin deficiencies

Deficits in the vitamin B complex impairs immune responses, and cell-mediated immunity in particular.

Pyridoxine (vitamin B_6) deficiency is the most serious, since it causes dysfunctioning of the thymus. Folate deficiency results in disordered DNA synthesis. Vitamin B_{12} reduces phagocytic and bactericidal activity.

Vitamin C deficiency impairs the mobility of phagocytes.

Vitamin A is instrumental in maintaining the epithelium and mucosa intact. It is active in both humoral and cell-mediated immunity, and is known as the "infection-fighting vitamin". A deficit causes impairment of the surface glycoproteins and lymphocytes, and disturbs antibody production ; it reduces the IgM concentration and may cause an increased incidence of respiratory and intestinal infections. In Bangladesh and Indonesia, it has been shown that children with xerophthalmia are highly sensitive to infections ; furthermore, children with subclinical deficiency may develop xerophthalmia when they catch an infectious disease (such as measles).

Vitamin E deficiency compromises cell-mediated immunity. It is an anti-oxidant and affords protection against free radicals.

BIOLOGICAL ASSESSMENT AND NUTRITIONAL REHABILITATION

Biological assays have only a minor role to play in the rehabilitation of malnourished children. They are mostly used for research purposes, since many pathophysiological facts are still not understood. Assays using micromethods are preferable, since these patients are anaemic. A single prick of the finger or heel yields enough blood to fill 9 to 10 capillary tubes containing 50 µl each.

In ordinary practice, biological assays are mostly used to diagnose an infection for treatment purposes, and must take as little blood as possible.

The haematocrit and haemoglobin assay are the most valuable blood indices for quantitating the extent of anaemia and determining the distribution of fluids between the interstitial and vascular compartments.

Testing for plasmodia and for HIV is important. The ionogramme is disturbed, but reliance on it is not only impractical, but actually dangerous, as seen above. Assays of prothrombin and bilirubin are of prognostic value.

The definition of a biochemical indicator of malnutrition which could be used to evaluate the extent of the deficit and for biological monitoring of rehabilitation would be most valuable. Albumin is a good indicator, but its 20-day half-life makes it insufficiently sensitive for monitoring rehabilitation. TBPA (thyroxin-binding prealbumin), with its shorter half-life, seems more satisfactory, but as mentioned above, malnutrition and infection very often coexist, and infections disturb these indicators.

Several teams have worked on indicators of inflammation measuring immune status, both for the monitoring of recovery in malnourished individuals and to provide a predictive tool. The outcome is not yet satisfactory.

Be this as it may, for the time being, clinical signs, anthropometrics and ongoing psychological observation remain the best instruments for evaluating children's progress. The biological approach is still in the research stage for now.

A specimen of fresh faeces should be examined for eggs, cysts and specific pathogens.

Urine may be cultured when the specimen is taken under sterile conditions, if resources permit. In case of perineal damage, suprapubic puncture may be done to avoid contamination of the specimen. Often pyuria is absent, and infection is attested by the presence of bacteria.

If tuberculosis is suspected, gastric tubage or laryngeal aspiration may be performed to test for acid-fast bacilli.

The biological disorders generated by malnutrition are numerous and varied, depending on the type and stage of the disease. They are indicative of the body's ability to adapt in order to survive.

Caution should be exerted when interpreting biological findings, especially ionogrammes, and data should consistently be situated in the pathophysiological context.

In practice, biological assays are mostly useful for detecting and diagnosing infectious conditions.

Blood tests should be kept to a minimum, and micro-methods used whenever possible.

NUTRITIONAL APPROACH

Malnourished children have tremendous needs but a considerably reduced capacity to eat and assimilate food. Any intake that exceeds their ability to assimilate is in fact dangerous.

Prolonged fasting leads the body to adjust to the absence of nourishment ; the organs all restrict their functioning to a liminal state. Metabolic activity is reduced. Because of the deficit in some micronutrients, certain enzyme systems are paralysed (this is the limiting factor effect). Infections further deteriorate the situation by increasing needs (parasites, imbalance in the digestive flora, etc.).

One key rule in treatment is that it must be maintained within the limits of the patient's metabolic possibilities.

The idea is not to correct the metabolic disorders uncovered, but to provide children with the means of rightening these disturbances themselves. Any overly aggressive treatment is dangerous. This is why the digestive route should be preferred to the venous route, which is too invasive for an organism with a severely disturbed metabolism. Renutrition using the digestive route enables the undernourished organism to adjust its intakes to its ability to assimilate, to some extent.

Management of nutrition must be global, with gradual increments of energy and protein, along with micronutrients and vitamins, any deficiency in which represents a limiting factor for metabolic activities. It is important, then, to act simultaneously to treat infections, compensate for deficits in nutrients and offer slow, gradual increments in energy and protein intakes.

NEEDS

Energy intakes

For healthy children, required energy intakes are estimated as follows :

110 Kcal/kg/24 h : 1-3 months
100 Kcal/kg/24 h : 3-6 months
95 Kcal/kg/24 h : 6-9 months
100 Kcal/kg/24 h : 9-36 months

In healthy children, this energy intake should be provided by carbohydrates (50 to 55 %), lipids (30 to 35 %) and protein (12 %).

Malnourished children have much greater needs during rehabilitation. First of all, their needs are increased because they must catch up on growth : in a matter of weeks, they reach a normal weight for their height. The weight gain may be as high as 10 to 20 g/kg/day. Next, infections entail increased consumption of energy. Energy needs may be as high as 200 Kcal/kg/d, or more.

Two facts are important, with respect to energy.

Malnourished children seem to have a lower energy efficiency - expressed as the ratio of weight increment to energy intake - than normal children. A malnourished organism requires more energy, so to speak, than a normal organism, to synthesize a gramme of

tissue. According to some paediatricians, this means that neither weight gain nor rehabilitation will progress until the undernourished child is able to cope with intakes of more than 150 Kcal/kg/d.

Energy intake should be viewed as a limiting factor in rehabilitation: rapid weight gain may be attained with a relatively moderate protein intake (3-4 g/kg/d), provided sufficient amounts of calories are supplied.

Protein intakes

In healthy children, the safe level of protein intake is the amount that covers or exceeds the requirements of the quasi-totality of the individuals in the group ; this explicitly takes individual dispersion of requirements into account, since they are defined by the sum of mean requirements and two standard deviations (cf. box below).

Age	g/kg/d
6 months	1.85
6-9 months	1.65
9-12 months	1.5
1-2 years	1.2
2-3 years	1.15
3-5 years	1.10

In the case of malnourished children, opinions differ : some specialists recommend an initial intake of 0.7 g of protein per kg and per day, while others favour 2 g/kg/d, and one study shows satisfactory results when marasmic children are given 3 to 4 g/kg/d.

Be this as it may, intakes exceeding 4 g/kg/d at the start of rehabilitation are dangerous, since the body is unable to eliminate large quantities of protein metabolites, owing to functional renal insufficiency. Furthermore, if the metabolic capacities are impaired by a deficit in some limiting factors, this protein intake increases the deficit and is not used for the synthesis of new tissue.

Polyunsaturated fatty acid intakes

Two polyunsaturated fatty acids - linoleic and linolenic acid - both of which are essential components of cell membranes, are indispensable and cannot be synthesized by the body. They are necessary for growth, maturation of the nervous system and the functioning of the enzyme system. Severe deficiency produces eczema-like lesions, resistant impetigo, dry, flaky skin, coarse, sparse hair, peri-anal irritation, exudating intertrigo in skinfolds, widespread erythema, frequent stools, decreased capacity for tissue regeneration and increased susceptibility to infections.

Protein malnutrition increases the need for essential fatty acids (EFA) and may worsen a deficiency. Irrespective of age, dietary fat should provide 3.5 to 5 % of total energy in the form of linoleic acid and 0.5 to 1 % of total energy in the form of linolenic acid, the ratio between these two fatty acids being somewhere around 4 to 6.

The main dietary sources of EFA are vegetable oils. Cow's milk does not contain enough EFA, whereas human breast milk contains satisfactory amounts.

Trace element intakes

Although accurate clinical descriptions are available for some of these deficits, reliance on clinical or biological diagnosis is disadvised, most of the time, because of the interactions between the various causes of the clinical picture seen in malnourished children: rather, they should immediately be viewed as deficient, and cared for as such.

Potassium

Since most studies document the presence of potassium deficiency, supplementation should be systematic at the start of treat-

ment. Some writers point out that potassium supplementation is dangerous prior to resumption of adequate diuresis.

The recommended dose is 4 mmol/kg/d, in the form of potassium chloride. An oral solution is prepared by adding 7.5 g of potassium chloride to 100 ml of boiled water. This solution contains 1 mmol of potassium for 1 ml of solution.

For healthy children, recommended intakes for potassium, designed to cover the necessary urinary, cutaneous and faecal losses as well as growth-related needs, are somewhere around 2 mEq per 100 Kcal.

Magnesium

Since potassium uptake is linked to the presence of magnesium, the latter should be given concomitantly, in the form of a soluble acetate or chloride salt, at the dose of 1 to 2 mEq/kg/d, representing 0.5 to 1 mmol/kg/d. Magnesium hydroxide should not be given, since it is not soluble.

Treatments incorporating magnesium seem to be more effective. Excessive protein or energy intakes aggravate the magnesium deficit and may partially account for the decompensation observed when too much protein or energy is given at the start of treatment.

When clinical signs of magnesium deficiency are seen, magnesium sulphate may be administered intravenously.

Breast milk contains 40 mg/l and recommended intakes for healthy children under age one year are 40 to 60 mg/day and 6 mg/kg/d for 1 to 10 year-olds.

Zinc

Since zinc deficiency plays a major role in the pathophysiology of malnutrition, supplementation with 2 mg/kg of elemental zinc in the form of zinc acetate, during nutritional rehabilitation, is conducive to faster recovery of normal weight as well as of immune defences. The addition of 20 mg of zinc acetate per litre of food, on the basis of 120 ml/kg of body weight, is recommended ; this corresponds to an intake of 2.4 mg/kg.

The zinc contained in breast milk has a far better bioavailability than that found in cow's milk or in complex food mixes, in which many factors (proteins, calcium, iron, citrates, phytates, fibre, etc.) interact.

Recommended intakes for healthy children are 5 mg/day during the first year and 10 mg/d for one to ten year-olds.

Copper

The consequences of copper deficiency have been discussed above.

Copper supplementation has been shown to be effective in certain children suffering from severe malnutrition. Some specialists recommend giving 300 µg/kg/d, for a total dose not exceeding 2.5 µmg/day during approximately 70 days, to achieve a normal weight/height ratio, blood albumin concentration and behaviour ; others suggest intakes of 80 µg/kg/d of copper during rehabilitation, while still others use copper acetate - 2 mg/l of food, on the basis of 120 µml/kg of body weight - in other words, 240 µg/kg.

The copper in breast milk has a better bioavailability than that in cow's milk, where its concentration is low. Requirements are estimated at 75 µg/kg/d in full-term children under one and at 40 µg/kg/d in 1 to 10 year-olds.

Selenium

This is a particularly important element, since it is an enzymal cofactor which protects the membranes against free radicals, which are believed to play a role in the pathophysiology of kwashiorkor. Furthermore, it stimulates immunity and participates in the metabolism of the thyroid hormones.

Cereal grains, meat (liver, kidneys) and fish are the main dietary sources of selenium. Recommended intakes are 10 to 15 µg/d in children under one and 20 to 30 µg/d in 1 to 10 year-olds.

A dose of 6-10 µg/kg/d, in the form of sodium selenate, may facilitate rehabilitation and avoid cretinism in case of dietary deficiency.

Iron

Iron-deficiency anaemia is very frequent in severely malnourished children. In nutritional rehabilitation, the administration of iron should be delayed (by about one week), to make sure that sufficient amounts of transferrin, a carrier protein, are synthesized : if not, the iron subsists in an unbound state, and is available as a growth factor for bacteria.

Waterlow (7) advises the oral administration of a total dose of 70 mg/d of $FeSO_4$ in two divided doses between meals, with or without folic acid, over a period of at least 3 months, after the first 7 days of rehabilitation.

It should be remembered that uptake is better for haeme iron (contained in meat and fish) than for non-haeme iron (in milk, vegetables, eggs). Both cow's milk and breast milk have a low iron content, but the iron in breast milk has a high bioavailability (close to 50 %). Healthy children have iron requirements of 6 to 10 mg/day during their first year of life, and 10 mg/d between ages 1 and 10 years.

Iodine

Recommended intakes for healthy children are 40 to 50 µg/d for children under one and 70 to 120 µg/d for 1 to 10 year-olds. Breast-fed infants whose mothers have an iodine-rich diet (including sea salt, fortified salt, fish, seafood, etc.) have a more than adequate intake.

Vitamin intakes

Vitamin A

Given the synergy between malnutrition and vitamin A deficiency, specialists unanimously recommend routine supplementation in at-risk regions, with intramuscular administration of 30 mg of retinol palmitate on three successive days immediately following the implementation of treatment.

The breast milk vitamin A content of a healthy lactating woman is somewhere between 400 and 600 µg/l. During the first year,

(7) Waterlow JC. Treatment of severe PEM in Protein-energy malnutrition. London : Edward Arnold, 1992.

recommended intakes are 375 to 400 retinol equivalents a day, and from 1 to 10 years, 400 to 700 RE/d (1 RE = 1 µg of retinol = 3.3 IU).

Folic acid

Under normal conditions, the recommended dose is 100 µg/d for 1 to 3 year-olds and 50 µg/d for infants under age one. Some workers systematically give 5 mg/d of folic acid at the beginning of rehabilitation.

Other vitamin deficiencies have a regional prevalence, and should be looked for in accordance with the local epidemiology.

THERAPEUTIC RENUTRITION

THE DIFFERENT STAGES

Conventionally, 3 or 4 phases of renutrition are described : the resuscitation phase (phase 1), first refeeding (phase 2), rehabilitation itself (phase 3) and preparation for returning home (phase 4).

Resuscitation - phase 1

This point has already been discussed : it involves correction of fluid and electrolyte disorders, treatment of infections, prevention of risks of hypothermia and hypoglycaemia. Gastric tubing may be necessary ; the venous route should only be used if the child is in shock. Two risks should be kept in mind : the possibility of sodium overload and of heart failure.

First refeeding - phase 2

As soon as the child's clinical status allows, refeeding should be begun, based on one golden rule : give little, slowly, patiently. To start with, a maintenance diet of 120 ml/kg - representing 85 Kcal/kg/d and 0.7 g of proteins per kilo and per day - along with potassium, magnesium and micronutrient supplements is recommended. Meals should be given frequently, in small amounts every two hours (12 meals on the first day).

Rehabilitation itself - phase 3

It is the child's clinical and psychological state (with recovery of appetite and a reduction of oedemas) that conditions the beginning of this phase. Once the child's appetite has returned, he or she may eat ad libitum.

During this phase, weight gain is impressive : as much as 20 times the normal increment at that age, which is 10 to 20 g/kg/d. The child may, on his or her own request, ingest as much as 200 or even 250 Kcal/kg/d. Waterlow estimates protein needs at 5.75 g/kg/d, and excessive intakes are unnecessary.

Preparation for returning home - phase 4

The goal is to prepare the child for the diet he or she will find at home, and to attempt to optimize the latter. Use, for rehabilitation, of local foods that are eaten daily in the region, and mothers' participation in meal preparation are the bases of education on food.

The frequency of meals should gradually be reduced, to finally comply with home meal schedules.

BREAST-FEEDING

Breast-feeding should be encouraged and, when feasible, pursued during rehabilitation. If perchance it is interrupted, it should be resumed, since it yields appropriate amounts of the micronutrients required by the child. The lactoferrin, lysosome and secretory A immunoglobulins present in breast milk are essential for the prevention of infections. Furthermore, breast-feeding re-establishes or intensifies bonding.

What food for nutritional rehabilitation

A mixture of milk, oil and sugar seems to be the most appropriate diet, at least at the start of rehabilitation. It constitutes a well-defined preparation, the composition of which is well-established and constant, with added calories provided by the oil when needed, and is easy to make in insecure situations.

With this type of preparation, intake may be increased gradually through modifications in the number of meals and the amounts given. With a starting pint at 75 Kcal/kg/day, an additional 25 Kcal/kg/d may be introduced gradually, every other day for instance, provided the child does not show signs of intolerance.

Some teams vary the composition of the mixture practically every day, so as to adjust it more closely to the child's theoretical requirements : this seems difficult to put into practice.

Waterlow recommends two preparations : one for the first refeeding phase, the second for the rehabilitation phase itself (cf. table 4).

Table 4
Preparations for rehabilitation

Item (g/l)	phase 2 (g/l)	phase 3 (g/l)
Powdered skimmed milk	17	110
Sugar	90	50
Oil	30	60
Caloria/protein content	700 Kcal/l 6 g of protein per litre	1,180 Kcal/l 38.5 g of protein per litre

Source : Waterlow JC. Treatment of severe PEM in Protein-energy malnutrition. London : Edward Arnold, 1992.

These preparations must be rich in nutrients. 120 ml/kg of the phase 2 mixture yields 85 Kcal/kg/d and 0.7 g of protein/kg/day. 150 ml/kg/d of the phase 3 mixture yields 175 Kcal/kg/d and 5.75 g of protein/kg/d.

Briend A. and Genaille V. recommend the use of a single, intermediate mixture (cf. table 5).

Table 5
Preparation for nutritional rehabilitation

Item	g/l
Powdered skimmed milk	80
Oil	60
Sugar	50
Potassium (Kcl)	1
Magnesium ($Mgcl_2$)	0.5
Water : qs 1 litre	

Source : Briend A, Genaille V. Détection et prise en charge des cas de malnutrition en populations réfugiées. Cahiers d'Etudes et de Recherches Francophones. Santé et Développement, 1992 ; 2, (6) : 369-376.

This mixture yields 100 Kcal and 2.8 g of protein for 100 ml.

Choice of one mixture or another depends on local conditions : size of the unit, available resources, personnel, etc.

While phase 2 requires a very accurately prepared mixture, intake during phase 3 should mostly provide large amounts of energy (175 to 200 Kcal/kg of body weight) along with 3 to 4 g of high-quality protein. It seems essential to use local products, and to combine them so as to produce a mixture that does not shock cultural habits ; the mother will then be able to prepare the same food at home, making semi-ambulatory care possible. Studies on diets based on local products have shown them to be valuable, and they definitely make for better maternal comprehension and consent, and easier application at the family level.

On the basis of the theoretical capacity of the child's stomach and of protein and energy requirements, the ideal protein-energy density of rehabilitation food may be calculated. The professional's main job, at that point, is to work out and test recipes for appropriateness, predicated on their compliance with well-defined overall characteristics (cf. table 6), as well as with specific local nutritional needs (for selenium, iodine, vitamin A, etc.) conditioned by the environment.

Table 6

Ideal characteristics of food mixtures for use in community-based nutritional rehabilitation of older infants and young children

Readily available, culturally acceptable food components
Low cost ingredients
Adequate energy density (≥ 80 Kcal/100 g)
Adequate nutrient : energy ratios to satisfy all nutrient requirements if sufficient energy is consumed
Adequate protein digestibility and amino acid composition
Adequate bioavailability of micronutrients
Appropriate renal solute load to maintain urinary concentration (< 600 mOsm/l)
Low osmolality (< 350 mOsm/l)
Low viscosity (liquid or semi-liquid consistency, depending on age)
Acceptable flavor, aroma, appearance for children and their caregivers
Reasonably easy to prepare within limited period of time
Resistant to microbial contamination or proliferation

Source : Brown K H. Appropriate diets for the rehabilitation of malnourished children in the community setting. Acta Paediatr Scand Suppl 374, 1991 : 151-159.

Local fruit and vegetables may be used for their nutrient and vitamin content, but at the beginning of rehabilitation such additions should be controlled, and medicated supplementation is often less risky.

The acceptability of these diets will be improved if they are worked out with the mothers and/or other members of the community who take an active part in the rehabilitation process. Exchanges of "knowledge" and messages about hygiene and nutrition are then much more easily understood and applied. With this type of approach, a predominantly curative rehabilitation centre may gradually design preventive programmes for the improvement of the community's eating patterns.

Nutritional monitoring

At the start of refeeding (phases 1 and 2), the child should be given the minimum theoretical intakes, which do not demand too great an effort : anorexia should not be overcome forcibly. The child should be spoon-fed by his or her mother, or a care person who pays exclusive attention to him or her ; enormous patience is necessary, since the interpersonal relationship is an essential aspect of this phase. Bottle-feeding is proscribed.

Monitoring may be based on dietary intake : the amount eaten by the child is recorded, and the energy and protein content deduced. From phase 3 on, the child must eat until repletion ; that is to say, the plate should not be completely empty at the end of the meal.

Weight gain is calculated in g/kg/d :

$$\frac{\text{weight (g) at end of phase 3 - weight (g) at start of phase 3}}{\text{weight (kg) at start of phase 3 x length of phase 3 (days)}}$$

Weight gain should be somewhere between 10 and 20 g/kg/d. A weight gain of 70 g/kg/week is normal ; during this phase, a child weighing 5 kg may gain 1.5 to 3 kg in 4 to 6 weeks.

Nutritional rehabilitation is considered satisfactory when the child reaches 100 % of the reference weight for height. The child must be closely monitored throughout this 6 to 8-week period. This does not imply a 2-month stay in the hospital ; while the first week requires the infrastructure of a medical unit, rehabilitation may continue in an appropriate centre or even at home once phase 2 or 3 has begun. A 2 to 3-week hospital stay may be just as profitable as a longer sojourn.

Severely undernourished children have enormous needs and a very limited ability to assimilate food.

Refeeding must be done slowly, gradually and patiently.

An insufficient amount of energy, micronutrients or some vitamins may be a limiting factor in rehabilitation.

Overly large protein intakes are not necessary.

Breast-feeding should be encouraged whenever possible. It affords protection against infections, has an appropriate micronutrient content and helps to restore good mother-child relations.

Mothers should participate actively in meal preparation, so as to facilitate exchanges of information between the health team and mothers, and to improve the family's dietary situation.

Monitoring of the adequate progression of rehabilitation is based on records of food intakes and calculation of weight gain in g/kg/d.

CULTURAL APPROACH

Familiarity with the life and development of children in their own cultural setting is a prerequisite, if rehabilitation is to be given every chance to succeed. Three areas of anthropology should be applied here : the anthropology of diet, social and cultural anthropology and medical anthropology.

THE ANTHROPOLOGY OF DIET

Understanding of the nutrition-related situation of a social group involves understanding the group's relations with its setting and gaining access to social relationships. Food and drink are an integral part of every ceremony and festive occasion. Learning about the paths taken by different foods, how they are prepared and distributed within the group and how they are eaten yields information on how the community functions, and on its history. Looking at what is on plates informs, upstream, on the economy of the society, and downstream, yields forecasts of health status, ability to work and diseases.

The body and food : a dynamic balance

In many cultures, and especially in Africa, health is viewed as the outcome of a balance, of which food is a part. Hot food is beneficial in cold conditions, and vice versa. This symbolic conception of heat and cold in food may be compared to the conceptions based on the humours of the body : according to Hippocrates, the human body is composed of four humours, which are hot, cold, wet or dry. Blood was described as hot and wet, yellow bile as hot and dry, mucous as cold and wet and black bile as cold and dry. These notions pervaded Europe during the middle ages, and were imported to the Spanish peninsula by Arab doctors. They have been transmitted to the peasant culture of Latin America.

In China, food is categorized as yin or yang, and a properly balanced diet corresponds to good health.

There is no universal rule governing whether a food is placed in one category or another ; this varies from one country to another, from region to region within a given country, as well as at different times of life.

In Malaya, birthing mothers are viewed as suffering from extreme cold, and must eat food reputed to be hot and avoid marrows, considered to be cold. This is not a matter of thermodynamics, but of the intrinsic quality of the food. Some hot foods - solid, fatty and spicy foods - provide energy and vitality and are related to male sexuality, whereas cold food, which tends to be fluid and tart, is associated with women's nature.

Other classifications pertain to heavy and light food : eggs and pork meat are viewed as hard to digest, and unfit for eating in the evening.

Dietary taboos

Social and religious dietary taboos prevail in many parts of the world. These taboos rule out the consumption of certain foods, since their ingestion is believed to have harmful consequences. I. de Garine distinguishes between permanent and temporary taboos.

Permanent taboos affect an entire population group : examples are the consumption of pork by Jews and Muslims, the Hindu taboo against eating any living being and "totemic" taboos (members of a same lineage cannot consume the animal or plant of which they are descendants). The food may be a sign of membership in a social group : in India, there are dietary taboos and privileges attached to different castes, and in several African countries some excessively "hot" meats are viewed as incompatible with women's nature. With few exceptions, however, there are hardly any permanent taboos with serious nutritional consequences. It is important that we be informed of them, and understand and accept them.

Temporary taboos, such as those enforced during Lent or Ramadan, mark important periods in religious experience. Others, such as those applying to pregnant or lactating women, infants, etc., are specific to certain times of life. There are also taboos linked to certain diseases. For instance, in Senegal, the Serers give feverish children with measles a special pap made of water and the pulp of the baobab fruit, believed to be less difficult to digest than the traditional dish made of millet.

Temporary taboos may have more harmful consequences on the food intake of vulnerable groups, since they often pertain to protein-rich food and apply to critical phases of life. For instance, during the weaning period a child may be prevented from eating animal protein, which is viewed as too strong. "The motivations behind these taboos express the desire for a material and symbolic adequation between the food eaten and the status of the person who consumes it." (8). Often these temporary taboos have a basis in reality. I. de Garine explains that if future mothers are obliged to respect numerous dietary prohibitions, it is partly because of the fear that they will have an overly large child and a difficult delivery. If weaned children are prevented from eating animal protein, it is partially to avoid the digestive disorders consecutive to the consumption of spoiled food, given the storage problems encountered in tropical countries.

Food and children's development

Some beliefs pertain to how the diet of the expectant mother influences her unborn child, while others are concerned with breast milk and its importance for the child's development.

In the Bambara culture, in Mali, light or heavy breast milk is believed to condition the speed with which teething occurs, as well as satisfactory motor development. This belief is behind the introduction of solid foods, which cannot be begun until the child is able to sit up and has some teeth (9).

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(8) De Garine I. Les interdits alimentaires d'origine sociale et religieuse. Revue Prat Paris, 1991 ; 41 (11) : 973-976.

(9) Bril B, Lehalle H. Le développement psychologique est-il universel? Approche interculturelle. Paris : PUF, 1988 (Le psychologue).

Similarly, animal milks are believed to be responsible for the child's development, with children fed cow's milk being slower and not as gay as those raised on goat milk, who are lively and petulant.

Social aspects of diet

"Society transmits its culture to its children during family meals, which form a context in which individual personalities develop, obligations toward the family group are shaped and customs receive reinforcement." (10). In addition, the way in which food is prepared often reflects adjustment to environmental conditions ; P. Farb cites the example of Japan, where food (meat and fish) is cut into tiny pieces. This reduces cooking time, and consequently economizes on fuel.

The reasons behind dietary customs

Sometimes there are scientific explanations for dietary customs. In Peru, for instance, the Quechua Indians customarily soak potatoes in muddy water, allegedly to avoid acid indigestion. Research has shown that the mud used is composed essentially of kaolin, which has a protective effect on the lining of the digestive tract.

In some parts of Africa, people eat fish that has been wrapped in banana leaves ; the acidity of the leaves dissolves the fishbones, making the calcium assimilable (11).

Anthropologists attempt to determine the reasons behind these dietary customs. Claude Lévi-Strauss has advanced an explanation in terms of mythology, while P. Farb and G. Armelagos view them as a combination of three factors : a technical/environmental aspect (the cultural system adjusts to its environment), a social aspect (reflecting the balance between individual members of the group) and an ideological aspect, expressing the way in which members of the group view the world, their own technical/environmental adjustment and their social structure.

C. Fischler (12) says that "man is an omnivorous creature, who feeds on meat, plants and the human imagination : food and diet refer us back to the biological, but clearly are not reducible to it. Symbols and the dream world, signs, myths and phantasies also provide nourishment, and determine our eating arrangements, to some extent."

"There is no future for solutions that do not take the long-neglected traditional wisdom into account", says Alain Froment (13). "There is much for anthropologists of diet to tackle : the reappraisal of the recommended intakes defined by international agencies, with special attention to adaptability to low intakes, the study

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(10) Farb P, Armelagos G. Anthropologie des coutumes alimentaires. Paris : Denoel, 1981.
(11) Ibid 10.
(12) Fischler C. La nourriture : pour une anthropologie bioculturelle de l'alimentation. Communications. Paris : Seuil, 1979.
(13) Froment A. L'anthropologie alimentaire, pourquoi? Revue ORSTOM. Actualités, sept/oct 1988 ; 22 : 13-15.

of energy expenditures entailed by heavy work in hot climates, the repercussions of seasonal cycles on health, an inventory of potentially edible resources, psychological reactions to changes in diet and/or lifestyle."

SOCIAL AND CULTURAL ANTHROPOLOGY

As mothers take care of their children, they more or less consciously incorporate experience from their own childhood, along with their culture's specific tradition of child-care.

The mother-child relationship (bonding)

To a casual observer, the behaviour of mothers living in Mantaro Valley, Peru, seems inappropriate to children's needs (14) : these Indian women hardly ever carry their children on their back or in their arms ; when nursing, they place them on a bed, come close and place their breast in the child's mouth, without touching it. Children must not become accustomed to being held by their mother, and must not be spoiled. They are raised very roughly ; when they begin to walk they do so alone, and are given very little help. Creoles and half-breeds contend that the Indians do not love their children ; immediately after birth, however, parents take very good care of their babies, although they refuse to pamper them afterward, so as to harden them, barring which they would be unable to survive at an altitude of over 4,000 m.

It is important to detach oneself from one's own cultural references so as to understand how people in other cultures behave : this is particularly true for the study of the mother-child dyad.

Eye contact may be viewed as the dominant mode of mother-infant communication in western culture, almost to the exclusion of skin contact ; conversely, profuse skin and kinesthetic exchanges seem to be the salient aspect of mothering in Asian countries. Some authors explain the latter attitude by the fact that the eye - the evil eye - is the focus of some superstitious fears with magical-religious connotations in India, whereas, throughout its history, the Catholic Church has consistently elicited feelings of guilt in the western world at any bodily contact and the eventuality that it might be pleasurable.

In Mali, a team of workers filmed child care ; mothering there seems to concentrate on vestibular stimulation, which is characteristic of African cultures : the child is held by its feet, swung about, shook up heartily, but in a very reassuring, loving atmosphere. Research has clearly showed that vestibular and labyrinthic stimuli (rocking) are not only very soothing, but also stimulate infant's visual alertness and motor development.

Culture and child development

H. Stork (15) has studied how children are held and handled in various cultural settings. In India, babies lie next to their mother, on a nat on the ground or on a bed ; during the day they are often in a vertical position, carried on the hip of an adult or an older

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(14) Allaga F. Pérou : vie quotidienne des indiens de la vallée de Mantaro. Paris : L'Harmattan, 1982.

(15) Stork H. Enfances indiennes, étude de psychologie transculturelle et comparée du jeune enfant. Paris : Paidos/le Centurion, 1986.

child, or placed in a hammock hung from the ceiling. African babies sleep alongside of their mother ; they spend much of their day in a vertical position, on someone's back. American Indian babies spend their nights in a hammock alongside of their mother, and are carried on the back or hip during the day. E. Werner has shown that babies raised in this traditional manner make faster psychomotor progress during their first year of life : African babies top the list, followed by Asian and Latin American babies ; Indian and African babies have an advance of up to three to five months in overall development quotient, in comparison with European and North American babies. They gradually lose this advance after weaning, however.

These examples show, once again, that a child's development cannot be separated from his or her sociocultural context. The mother-child dyad is a sort of microcosm representing the immediate setting and surrounding culture. This approach is an important part of nutritional rehabilitation, as well as of any other health programme.

Culture and how children are fed

In addition to its nutritive value, breast-feeding has frequently been described as a period of highly intense mother-infant relations. From the start, feeding time is a time for exchanges, stimulation and learning, and not simply for appeasing hunger by the incorporation of food.

The weaning period is a crucial time for children. There is an increased risk of psychological trauma when breast-feeding stops, because of the need to adjust to other types of food. In many cultures, when mothers decide to stop nursing, they smear hot, spicy substances on their breasts so that the child will reject them.

Since the mother-child relationship is particularly intense in traditional African settings, as we have seen, weaning too is very emotionally charged. Children go from a privileged position in which they have special ties, to one in which they receive less attention and care from their mother. Weaning is the second catastrophe, after birth, for the child's narcissistic structure ; it corroborates that first separation.

In a great many places, women who become pregnant again while lactating cannot go on nursing : sometimes their milk is viewed as "bad", or it is believed that the child to come will not be "normal". This is one reason for sudden weaning. In Africa, children are often viewed as the owners of their mother's milk ; the first-born has no right to drink the second-born's milk.

In some parts of East Africa, intercourse between a lactating woman and her husband is prohibited. If a woman becomes pre-

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(13) Froment A. L'anthropologie alimentaire, pourquoi? Revue ORSTOM. Actualités, sept/oct 1988 ; 22 : 13-15.

(14) Aliaga F. Pérou : vie quotidienne des indiens de la vallée de Mantaro. Paris : L'Harmattan, 1982.

gnant less than three years after the birth of a previous child, social exclusion is such that mothers have occasionally been known to commit suicide or kill their baby.

Weaning is often mentioned as a risk period for malnutrition, and as playing a non-negligible role in generating malnutrition ; in fact, research done in Senegal on Wolof children points to a much more positive interpretation. According to the African value system, weaning is a rite of passage, a structuring stage in the social development of African children, rather than a sudden trauma, arbitrarily imposed by custom. Further, close scrutiny tends to show that weaning, viewed as a dietary transition, is not as traumatic as has been contended, provided it is done gradually ; it is a much more complex process by which the mother-child relationship is modified.

All of these studies, most of which were conducted in rural settings, must be handled with caution by people working in urban contexts : the situation may be quite different in slum districts. The important point here is that children must be situated within their own culture, and the difficulty is even greater for programmes working with migrant groups.

MEDICAL ANTHROPOLOGY

The body and how it functions

For a doctor, diseases have a cause, symptoms and possibly a treatment. For an anthropologist, they have other dimensions : they are culturally meaningful and perhaps even socially functional. These interpretations are not necessarily very compatible with rational, scientific explanations.

Malnutrition must be treated by appropriate care, but it also involves a change in the attitude adopted by the mother and any other family members caring for the child. Such changes should be induced by the treatment team, which works at enhancing an awareness that is not in opposition to beliefs and traditions, but rather, that must carve out its place in the customary system. This mutual enrichment of wisdom requires that health workers comprehend the cultural dimension of illness.

In many cultural settings, no connection is seen between the clinical symptoms of malnutrition and a qualitatively or quantitatively insufficient dietary intake : firstly because mothers probably find it intolerable to admit that they are physically unable to feed their child properly, or do not know how to do so, and secondly, because there is another functional explanation for malnutrition within their social group. These explanations often have nothing to do with the known pathophysiological links, so that mothers who are told that they must feed their child more protein will find that such a step is useless, and perhaps harmful.

In the western world, allopathic medicine views medical conditions in causal terms ; that is, a specific aetiology generates a known corpus of symptoms for which appropriate treatment may be defined. This analytic approach focuses on the disease rather than on the patient. In other cultures, it is the individual (his or her past

history and social ties) who is central to pathology, and in the case of a child, it is the mother's proper conduct within her social group.

Frameworks for describing medical conditions

Quite often, the functioning of the human body is perceived in terms of the circulation of humours (blood, milk, sperm), through which an energy balance is achieved. This balance is affected by the diet, the weather and emotions, but also by "supernatural" occurrences connected with the group's history.

A child's sickness is not necessarily attributed to a rational cause, but rather to the contravention of taboos. In some parts of Africa, sexual intercourse is not allowed during lactation, because the mother cannot simultaneously be the object of lust, as a woman ; the man's sperm poisons her milk, which is reserved for her child. The child's sickness is interpreted, then, as resulting from an offence committed by the mother : she cared more about her husband than about her child.

In Africa, children are often viewed as reincarnations of an ancestor, either in person or through his or her name. If they are sick, then, or die, the cause is sought in some wrong done to the ancestors.

In Latin America, peasants view the world in terms of an equilibrium between heat and cold. The comets, stars and sun are hot, the moon and the clouds are cold. A person who eats too much hot or cold food may fall ill : recovery involves restoring the equilibrium. A peasant woman takes care not to leave her home while she is cooking tortillas : the shock of the cold air against the heat of her body might make her sick. A woman who suffers from insomnia eats raw lettuce, since the tepid leaves draw off the heat that prevents her from sleeping.

In the Aymaro-Quechua worldview, disease is defined as an incident occurring in the body, the mind or both, resulting in an imbalance caused by an internal or external aggression, with lasting, occasionally progressive and frequently irreversible effects. There are two conflicting concepts of disease, one mythical, the other naturalistic.

In the mythical conception, disease is usually the outcome of an aggression by a demiurge or a devil, more or less in human form, coming from a hostile environment or from the Pacha Mama (Mother Earth, the highest divinity, who is both kindly and demanding), which produces permanent damage in either the body or the spirit. The demiurge may take possession of the spirit, pull it out of the body, and leave it to wander around while the body gradually loses its vitality. Practices such as the reading of coca leaf tea or of guinea pig (yatiri) entrails, etc., are used to cure this disease. After that, the disease can be diagnosed, the causes found and a treatment prescribed.

As opposed to this mythical conception, there is what is known as natural disease, produced by an external agent remaining out-

side of the patient, as in any attack that does damage to the body but has no direct effect on the spirit.

Disease is perceived as something that makes the body react by cold or heat : loss of spirit is viewed as a cold disease, whereas the presence of devils in the body produces fever. Reputedly hot treatments are applied in cold sicknesses, and vice versa, the purpose being to restore the natural balance. This classification is particularly evident in natural diseases for which remedies from the mineral, plant and animal reigns are used. In childhood diarrhoea, for instance, treatment is based on the type of diarrhoea ; since it is believed to be a cold disease, the patient is given herb teas with a "hot" symbolism, made to fast (food is believed to be harmful) and warmed up. When supernatural causes are involved, various rites are practiced to ward off the disease-inducing spirits.

The vast majority of diseases affecting small children are believed to be "magic", indicative of how volatile and unstable children's souls are ; this is the rationale for high infant mortality.

Let us take three of these diseases, two of which are specifically attached to the age with which we are concerned. F. Aliaga (16) describes a condition encountered in Indians in Peru's Mantaro Valley : "el susto". The sickness occurs after an accident causing fright in the child. He or she may fall out of bed, or be frightened by a domesticated animal. The child's soul is said to escape in the fright. The child suffers complete loss of appetite, shudders during sleep, loses weight and dries up. Similarly, there is "el amartelo", the nostalgia of a baby who is prematurely separated from his or her mother for some reason. "El aya orejasqa" is caused by the smell of a corpse : it occurs when a child or a pregnant or lactating woman attends a wake or walks past a cemetery.

In these three cases, the child's soul leaves the body, placing a mortal threat on it. In all three cases, the symptoms of malnutrition are seen : loss of appetite, anorexia, rickets, weight loss. To cure this sickness and also to prevent it, some specific rites must be performed, and especially the "yatiri" must be sent to search for the child's soul.

In this context, it is difficult to persuade the mother that her child is sick because of a lack of adequate food. Cultures should not be viewed as completely static, however : ways of thinking change when different cultures meet, customs are transformed while their historic content is retained. There is no definite recipe for education : rather, an open ear and an open mind must be developed.

For the Andean peoples, as in many other regions, the death of a child is believed to be a natural occurrence : death is not the end, but the beginning of a new state. Religious syncretism is at work here : there is no reason to be sad, since the child is viewed as a little angel, freed of sin, who will go directly to heaven. The mother

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(16) Ibid 14.

must not cry, because crying may summon back her child's soul, which will then wander through eternity.

The "shame" of mothers of malnourished children

The guilt feelings and wounded narcissism experienced by mothers are variable in intensity and outlets, depending on the cultural context, but they always exist. This is one aspect of the "mother/malnourished child relationship" problem.

Every mother feels guilty when her child is sick, and some beliefs increase these guilt feelings. Sickness shows that the clan's rules have not been respected. The mother is publicly humiliated, since her ability as a mother is called into question by the community. The mother may then feel somewhat aggressive toward her child, and this should be expressed. In such cases, the close connection between social and cultural pressure and psychological behaviour is evident.

When a pregnancy occurs at a time when it is frowned on by the traditions of the group, it is attended by increased anxiety. The aggressiveness is turned against the child, and is structured around him or her, using traditional imagery, which partially relieves the mother of her responsibility.

A multidisciplinary analysis

The interconnections between the different fields are now clearer. There is no conflict between types of analysis, but rather, they complete each other to provide a better understanding of what is going on. The medical model, supposedly all-powerful, must be replaced by this multidisciplinary, analytic work (cf. figure 8).

Socioeconomic approach			
Community →		Family →	Child
Nutritional approach	Behaviour →	Deficient diet →	Malnutrition
Psychological approach	of mother →	Disturbed mother-child dyad →	Malnutrition
Cultural approach	and child →	Cultural reference system : dietary traditions, breast-feeding, weaning, logic of the culture →	Malnutrition

Figure 8 : Multidisciplinary analysis.

Any educational effort aimed at changing ancestral customs may create a destabilizing malaise which generates insecurity and, consequently, lack of psychological availability. Such education is no more than a delusion when the quality of bonding, with its vast underlying experience and atmosphere, is not good. This points to the importance of a multidisciplinary approach, of ethnopsychiatry, and of intercultural research.

No-one can turn into an anthropologist overnight, but it is important for people to be open to the cultural dimension of sickness. Some physicians and anthropologists are working at finding ways by which their different fields of action may engage a dialogue ; "Rapid (anthropological) Assessment Procedures" have been developed (17). The purpose of these is to obtain information about cultural aspects which is directly applicable to health action. Doctors are able to reach a diagnosis relatively quickly, but this is

(17) Le "RAP" et les méthodes anthropologiques rapides en santé publique. Cahiers Santé 1992 ; 2 : 300-306.

rarely the case for anthropologists, who require a much longer observation period. These RAP are highly controversial, but it must be admitted that they have the merit of attempting a more comprehensive approach to health problems.

Some information about the anthropology of diet must be obtained before starting any nutrition-related intervention, be it preventive or curative.

Analysis of the mother-child dyad requires that it be situated in its cultural context.

A synthesis of social, medical, nutritional, cultural and psychological approaches is absolutely necessary if we are to achieve a global understanding of malnutrition.

PSYCHOLOGICAL APPROACH

This chapter discusses the impact of disturbances in the child's psychological environment, and especially in the mother-child dyad, in generating malnutrition.

THE ROLE OF THE PSYCHOLOGICAL SETTING IN MALNUTRITION

Why do some children develop malnutrition while others, in comparable urban or rural socioeconomic contexts, do not? Among siblings, why is one child affected rather than all boys and girls? Kwashiorkor apparently does not occur only in particularly poor or conflict-ridden families.

There is a specific psychological picture of children with kwashiorkor : children with other diseases (such as pneumonia and malaria) have been given psychological examinations and testing. Irritability and despair are definitely characteristic features of kwashiorkor (18). Emotional withdrawal is more evident and more constant than in other illnesses.

For a same degree of poverty, unsatisfactory mother-child bonding makes a child particularly fragile. Some prospective studies have shown that malnourished children had very low maternal stimulation scores starting at 6 months of age, and before malnutrition had developed. Several researchers have described interpersonal, social and psychological situations conducive to an increased risk of malnutrition. These include : a child who is not raised by his or her mother, an undesired pregnancy, a broken home, a psychologically immature mother, etc.

Explanatory hypotheses

Some writers point out that the early weaning behind marasmus may be the mother's response to her child's passivity or ineffectual sucking. Others suggest that malnutrition may, conversely, be the cause of mother-child discord.

Certain studies indicate that kwashiorkor rarely occurs in powerfully integrated social groups ; it characterizes groups having lost contact with their traditions (mothers who have recently arrived in an urbanized environment and are deprived of their cultural bearings, for instance). When kwashiorkor was first described, its psychosomatic dimension was immediately perceived, and two aspects were stressed : depression and rivalry, with arrested psychomotor development, serious impairment of alertness and relational difficulties (rejection of contact and of play with others or with objects). The descriptions mention anorexia nervosa in kwashiorkor, and a depressive daze in response to a sudden change in the mother-child relationship in marasmus.

The mother-child dyad

A symbiotic relationship

Traditionally, children are closely bonded to their mother as soon as they are born. Contact is permanent, establishing a real symbiosis : at night the baby sleeps with the mother, during the day he or she is carried on her back, is nursed on request, and his or her slightest desire is satisfied. In many societies, sexual intercourse is

(18) Geber M, Dean RFA. Les changements psychologiques au cours du Kwashiorkor, Devenir 1991 ; 3 : 12-35.

even ruled out ; the child, sovereign, is the main focus of attention. Any aggressive feelings toward the child are closely controlled ; this symbiosis generates great security, but is an experience of total dependency. During this period, children's psychomotor development is often extremely rapid.

Emotional deprivation

The fact that emotional deprivation plays an essential role in the development of malnutrition was first mentioned in 1956. Often children at risk of undernourishment live in an environment where family exchanges are reduced to a minimum, and mothers, unaware of their child's cognitive needs, have a passive attitude. Inadequate stimulation within the family and low mother-child interaction are encountered in most infants who go from second degree to third degree malnutrition.

Weaning and separation

Weaning is intentionally sudden, at an age ranging from 6 months to 2 years, depending on the case, and is sometimes accompanied by a separation, so as to pay homage to the father's mother, but also to emphasize the beginning of a new phase in socialization. The unique, child-centred bond with the mother is replaced by strict education in a different place, with unfamiliar people. Although this delicate phase does not induce malnutrition in most cases, it is often plagued by bouts of infection. With weaning, the mother's attitude suddenly changes, and the child may experience her refusal to nurse as a form of rejection. Weaning and separation are frequently encountered as factors in case histories of malnutrition.

Depression and the sick child

Depression is now acknowledged to characterize the psychological disturbances seen in kwashiorkor : psychomotor retardation, apathy and negativity are documented. In marasmus, the sudden destruction of the mother-child dyad has immediately visible, dramatic consequences, whereas kwashiorkor occurs later, when the mother-child relationship is already more complex and the underpinnings of the child's mental organization are already somewhat consolidated.

Malnutrition reduces the child's ability to stimulate his or her mother, and consequently, the mother's response is less intense. In a normal process, mother and child are protagonists in a positively dynamic situation : the infant's skills induce the mother's skills, whereas the mother induces the baby's skills. In malnutrition the cycle is reversed. An unsatisfactory psychological atmosphere is conducive to the occurrence of the illness, and a psychological trauma may hasten its course.

TOOLS FOR WHOLESOME DEVELOPMENT

Developing children have vital needs that extend far beyond the need for protection, food and care. They are nourished by affection, interaction and stimulation as well. A feeling of security, generated by a coherent environment, as well as play as a means of exploring and discovering the world are essential.

Children's needs

Importance of bonding

Children should be viewed as active individuals, and as equal partners in the relationship.

There are three levels of interaction between a mother and her child :

- first, behavioural interaction, through which the behaviour of both mother and child adjust to each other ;

- next, emotional interaction, which involves reciprocal influences between the emotional lives of baby and mother. Infants are able to detect variations in the affective quality of their mother's behaviour at a very early age. If the exchange is not satisfying, the child attempts to reorient the interaction. If these efforts are unsuccessful, he or she then loses interest and becomes passive ;

- last, there is interaction on the phantasy level, which is to say that a child affects his or her mother's mental life. The child's existence refers the mother back to the good and bad experiences of her own childhood, and this is a moving experience for her.

The development of mother-child bonding is a complex phenomenon, with an interactive dynamic. This relationship is the outcome of reciprocal reactions between two human beings who are interacting, with all of their individual peculiarities and the specific features of the society in which they live (cf. table 7).

The concept of vulnerability may be defined as sensitivity to risk factors, the latter being variable in children (at different stages of their development, for instance), but also in mothers.

These interactions form an ongoing process of mutual adaptation and adjustment (to contingencies) : at each phase of the infant's development there is a corresponding stage of mothering, and a new pattern of interaction.

Table 7
Dynamics of interaction : longitudinal evolution

Mother Mothering	Interactions	Infant Development
Her history The history of her couple	Behavioural	Physical equipment
Her personality	Affective	Temperament
Skills	Phantasies	Skills
Risk factors		Risk factors
Her vulnerability		Vulnerability
All variants between : Successful adjustment → Failure		
Harmonious interaction		Disturbed interaction

Source : Lamour M, Barraco M. Les interactions mère-nourrisson. Prévenir et protéger. Dossier, 1991.

Greenspan and Lieberman (1980) define three types of maternal behaviour (19) :

- contingent behaviour : the mother's behaviour is interpreted as a direct, appropriate response to the infant's cues, and corresponds to the infant's behavioural goals as assessed by the observer ;

- non-contingent behaviour : the mother does not respond to the baby's cues, or does so inadequately ;

- anti-contingent behaviour : the mother's response to the baby's cues is the opposite of what the baby desires or seeks, as interpreted by the observer.

The same types of behaviour in infants, and of interaction within the mother-child dyad may also be described in terms of "areas" of contingency, non-contingency and anti-contingency. An area of contingency is defined as an interactive sequence in which contingent behaviour is predominant in both infant and mother.

This relationship begins during intrauterine life, in the mother's imagination, then in her gradually changing perception of a growing, moving body within her. At birth, the real child replaces the phantasied child. The first stumbling block in this relationship may arise when the dream and reality come face to face : if the child is not of the desired gender, for instance. Interactions grow increasingly perceivable as the first days go by. At birth, the neonate already has a considerable capacity for sensory perception (touch, smell, sight, hearing, smell), relations (noises, crying, movement) and remembering.

Brazelton points out that babies are born with excellent means of making their needs and gratitude known to those around them. In fact, they are even able to choose what they demand of their parents, and to reject anything that is undesired, in so powerful a way that, far from being putty in their hands, he views them as extremely forceful beings, capable of neutralizing and influencing those around them (20).

Food and bonding

If a baby is to be adequately nourished, bonding must be satisfactory. Food has several dimensions : a physiological one, with energy and protein intakes, and a psychological one of stimulation, and relations with what is eaten. Food provides a great variety of stimuli through its texture, colour, flavour, taste and temperature. Eating has interpersonal and psychosocial dimensions. It is also a vehicle for family, social and cultural symbols. Food symbolizes the first tie, an oral relation to the mother as object. The child's dietary balance is closely dependent on a harmonious relationship with his or her mother, within a dynamic context strongly affected

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(19) Greenspan SI, Lieberman AF (1980). Infants, mothers and their interaction. A quantitative clinical approach to developmental assessment. In SI Greenspan, GH Pollock (eds). The course of life, vol 1, DHHS Publ (ADM) : 80-786, Washington, DC, Government Printing Office : 271-310.

(20) Brazelton T. Dynamique du nourrisson. Paris : les éditions ESF, 1982.

by social and cultural pressures. During early infancy, eating is an act of love, and attests to bonding ; the newborn baby achieves an equilibrium by appeasing its hunger, and experiences pleasure when the uncomfortable feeling of hunger gives way to one of fullness. The baby may associate eating with a time of pleasure and intense closeness with his or her mother. Similarly, the mother feels pleasure when she feeds her child well ; she feels reassured in her motherly role, her healthy child affords her with recognition as a good mother within her community (the reverse being equally true). Feeding/eating is an act of love, attesting to a balanced mother-child relationship.

It is essential that health workers, and midwives in particular, be aware of the importance of these interpersonal dynamics, so that they may work toward early prevention of disorders within this relationship, from birth on.

PSYCHOLOGICAL INTERVENTION DURING REHABILITATION

Very broadly speaking, five successive behavioural patterns may be described for malnourished children undergoing rehabilitation. The case of kwashiorkor will be used to illustrate these, since it involves the most obvious behavioural disturbances.

CHANGES IN BEHAVIOUR

Rejection

When taken into care, a severely malnourished child with kwashiorkor is very withdrawn, and shows no interest whatsoever in the surrounding environment. The picture is always the same, with only slight variations depending on the child's age : he or she frequently adopts a foetal position, completely huddled up, or remains put, motionless and passive, when placed in any position. The gaze is empty, with not a glance at any object or person ; there is a complete absence of dynamism, with few, slow motions. Despite apparent sleepiness, the child is not really asleep, but in a state of disconnectedness from the surroundings, a state of non-relatedness, of indifference to the staff, and to his or her mother as well. No demand is formulated, either by a motion or by the eyes. The only efforts at expressing anything are monotonous, complaining grunts ; the eyes are averted, and reflect refusal to communicate, depression and fear. Sometimes even aggressiveness has disappeared. When someone attempts to communicate, he or she refuses the contact, with averted eyes, and grunts. When touched or approached, a pained facial expression and more intense grunting express aggressiveness. Loss of sphincter control and repetitive motions are other frequent signs.

The mother-child relationship is often extremely meagre, with an ambivalent attitude, skin contact maintained but no eye contact ; the mother seems only to go through the motions : her gestures are weak, passionless, with no emotional content. Her attention is directed to other children or staff in the room. When visual and tactile exchanges are lacking, mother and child become spectators rather than actors in their relationship : the child is passive, and seems to be a package placed on the mother's lap, while the mother remains motionless, or makes loveless gestures. When offered a toy, the child looks away.

During this period, which corresponds to the clinical resuscitation phase, the only grounds for contact are care and feeding. But every act is experienced as violent by a child who refuses to live, and especially feeding (with gavage, feeding tubes and/or infusions). Body contact, on the other hand, through gentle handling when changing the child (because of frequent defecation) may gradually pave the way to a relationship based on the physical pleasure of touch. It is important to view anorexia as one way of expressing refusal. The child seems to use rejection of food to assert his or her negation of any relationship : food then fully assumes its symbolic dimension as a "vehicle for relating".

This description is mostly valid for protein energy malnutrition of the oedematous type ; marasmic children, on the other hand, retain their appetite, remain in contact with others and express their desire for interpersonal relations. The situation described above lasts for about one week and coincides with the resuscitation phase, the subsiding of oedemas and anorexia. Skin problems improve.

Consent

Gradually, the child begins to accept food, and eating comes to be the first voluntary contact made with the outside world. His or her attitude toward the surroundings changes, but the evolution depends on what infection or treatment-related problems arise. As the child's eyes come to life, the second barrier seems to fall. With the improvement in physical condition, the child is able to sit up, but still remains indifferent to relations with others : only his or her gaze takes in the surroundings, as he or she rests inert in bed or on the mother's lap. There is no longer any inexplicable grunting ; occasionally, during care, the child may be somewhat aggressive, and then makes louder noises. When handed a toy, he or she either rejects it, by throwing it at the person who has offered it, drops it, or just holds it briefly. The eyes are livelier, with some interest for what is going on. At this point, eating is still passive, but food is accepted rather than rejected.

Discovering the environment

A third step seems to be reached when the child begins to take interest in other children, is intrigued by their play but is not ready to take part in it : relations with others still make him or her uneasy. There is a need for security. But, when given toys and allowed to discover them by him or herself, the child does take them, with a facial expression which then loses the expression of absolute distress seen during the first period. The child's attitude toward the mother changes as well, and an expression of discontent may be seen when she leaves ; the same is true for the health workers. He or she no longer grunts when held, but remains passive.

Active bulimia and hungering for affection

Then comes a period that may be termed active, since the child characteristically seeks out exchanges and has the definite desire to discover the outside world. Older children begin to speak again. Gradually the child arrives at the point of motor development corresponding to his or her chronological age, and moves toward whatever he or she finds attractive. A bulimic need for affection pushes him or her toward the staff as well as toward his or her

mother ; the child deliberately holds onto the person who is taking care of him or her, wants to be caressed and seeks affection, physical and tactile contact, to reinforce a feeling of security. When put in bed there is crying and demands to be held. Aggressiveness is expressed when the mother leaves. Older children begin to feed themselves again.

Competition, demands

During the last period the child is extremely active and boisterous, takes possession of the space, and may engage in rivalry with other children. Children over two use toys to express their territory, their need to dominate, their identity. Conflicts with other little patients arise, and the demand for affection remains strong.

This description is deliberately oversimplified, and even caricatured, so as to point up the different phases in children's evolution during nutritional rehabilitation. These vary, of course, depending on a number of parameters including the child's age and clinical evolution, but also the mother's attitude. The length of these different phases varies as well, for different children, and does not necessarily coincide with their physical or biochemical improvement. Some children continue to look sad and miserable, although their physical disorders subside. Others become normal, behaviour-wise, although their physical condition remains poor.

The question of the mother-child relationship

Quite often, a mother who turns her children over to the rehabilitation centre, views him or her as dead, and is totally rejecting. She has already been informed by her social group that a fatal outcome is unavoidable. The mother then has a defensive attitude, and rejects an intolerable relationship with a dying child who designates her as a bad mother. That status is hard to bear in any culture. Guilt, and wounded narcissism, then probably play a key role.

When the mother-child relationship is not too badly damaged, some mothers find their desire to communicate with their child revived when the latter regains a taste for life. They become active instead of passive, hold their child, caress him or her and feed him or her carefully. But sometimes the mother prefers to leave the nurses in charge of the child, and has no desire to take an active part in care. If no dynamic relationship is recovered the mother-child dyad suffers, and a therapeutic approach is required.

As Guedeney writes : "the quality of the mother-child relationship is clearly the key factor which determines the child's prognosis, in terms of the pace and quality of recovery, and perhaps the seriousness of the illness itself" (21). It is important to remember, then, that mothers should never be excluded from the therapeutic intervention, even - and especially - during the resuscitation phase, a time at which all of the protagonists are necessarily in conflict, when faced with the child's refusal to live.

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(21) Guedeney A. Les malnutritions et le sevrage sous les tropiques : pour une théorie psychosomatique du Kwashiorkor. In Brusset B. Nourrir un enfant. Paris : editions Privat, 1986 ; (6/7) : 159-173 (Lieux de l'enfance).

Children's evolution in the course of rehabilitation is most striking : from the pseudo-foetal position in which they arrive, they seem to relive all of the phases of their psychomotor development in a matter of weeks.

THE INTERVENTION ITSELF

Spatial organization

Aside from the resuscitation phase, which takes place in bed, children should be given space, security and stimulation for exploring and making progress. "Medicalization" of the facilities is traumatic, and hence, undesirable : the space should be arranged so as to respond to different needs.

Hygiene should be satisfactory, and the environment generally functional, so that caregivers may work under proper conditions. The set-up should not make mothers feel excluded or rejected, and should facilitate their exchanges with both their child and the staff to the utmost. Conflicts with the staff should be avoided, however, and mothers should not be allowed to totally invade the health centre. All in all, then, the facilities should be organized so as to be conducive to a balanced relationship between all three partners : the mother, the child and the caregiver.

Psychological/affective stimulation

Next, when feasible, it is important to create an area in which children may run, climb, hide, and use all five senses to discover spaces, shapes, colours and sounds. They should be helped to retrieve their desire to learn in a setting where they feel secure. This space may help the mother-child dyad to evolve toward a less alienating relationship, as it awakens the child's desire for discovery and play. Separation from the mother will then be experienced as something positive rather than simply as a frustration. This space should also encourage group experiences, where the child can meet others at play, as well as in mealtime encounters ; this makes socialization possible. It is preferable that this space not be designed in a way too foreign to traditional local standards.

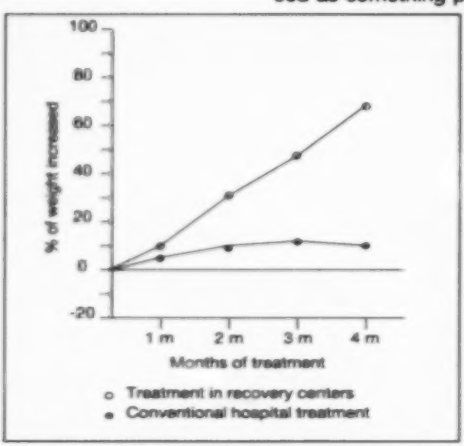

Figure 9 : Weight increase in 70 severely malnourished infants after 4 months of treatment.
Source : Monckeberg F. Treatment of the malnourished Child. In : Suskind M. The malnourished child. Nestlé Nutrition Workshop Series, 1990 ; (19) : 339-359.

Psychological/affective stimulation clearly is conducive to better nutritional rehabilitation. In Chile, Monckeberg compared two groups of malnourished children under age one year : both groups were given the same therapeutic diet, but one was treated in a specialized centre and received affective and motor stimulation, whereas the other group received the usual hospital treatment. Differences were evident, with more prompt recovery for children in the stimulated group, with no adjustment period : weight and length gains were significantly higher (cf. figure 9), they suffered fewer infections and no death occurred in the stimulated group, as opposed to 29 % mortality in the hospitalized group.

Every nutritional rehabilitation programme should include support for the mother-child dyad, so that the mother (or other adult) may develop stronger emotional ties with the child, and interactions between the two partners may occur. Such action should consolidate and promote the development of bonding, by improving the nutritional status of both, but also by fostering dynamic communication between them.

A number of programmes for play-mediated, psychosensory, physical and affective stimulation have been experimented, with the participation of volunteers and of the children's mothers, in particular. "Psychological help" should be visualized for severely malnourished children during rehabilitation, when local resources permit.

Being receptive

Whereas people tend rapidly to lose interest in these sad-eyed children, and to be bored with them, it is important, on the contrary, to be receptive and extremely alert. This sustained attention enables children to initiate encounters, and avoids having them perceive any advance as a form of violence. Mothers too should be given attention, so that they feel desired as mothers, and revalorized and relieved of their guilt feelings by the attitude of the caregiving team.

Appropriate action

Many writers, such as Brazelton, have emphasized the need to act through adequate stimulation of each infant. If the intensity is insufficient for a specific child, the stimulus is not given attention, or does not sustain interest ; if it is excessive, the child withdraws.

Psychological intervention has a number of objectives. The first is to restore the perception of a reassuring, stable environment through a relationship with a single caregiver attached to one particular child. Secondly, and at the same time, it aims at restructuring the mother-child dyad : that is, at creating a positive, gratifying image of the relationship for the mother, but also for the child, by bringing out the reassuring side of the relationship. This requires availability and receptiveness, being a guide but never a substitute.

Last, two types of intervention are used to further stimulate children : first, they are offered situations which they are able to control and master (a light, easily held object is preferable to a large, heavy one), and secondly, a stimulating environment is provided.

Massages

In many societies massaging children is common practice, and is the source of a wealth of physical contact between mother and child. In India, for instance, massaging babies is an ancestral, almost ritual practice : twice a week, the mother bathes her child in oil. The baby rests in the cavity formed by the mother's two outstretched legs, pressed together, as she gently spreads the oil over the child's body with her bare hands, massaging it from the spinal column outward.

These practices, which are an integral part of some cultures and are easy to set up in treatment programmes for severely malnourished children, seem quite valuable, especially when contact is difficult. Such gentle, gradual massages should of course be performed only if the child tolerates them.

The function of play

Play should be used, when the child's condition permits. It revives and intensifies physical activity. According to some specialists, play, involving taking, throwing, pouring, creating complicated balances, catching, rolling, moving, etc., is truly an introduction to learning. These acts help children to learn motions, improve their coordination and enhance their accuracy. Relation-wise, play helps children in their contacts with their environment, their mother, the staff and other children. It awakens and stimulates them, through the pleasure of discovering and creating.

The main problem involves discovering the level and type of stimulation appropriate to the developmental phase of the particular child, so that the situation will be a positive one rather than generating failure. During malnutrition, skills regress considerably. Children who were able to walk no longer do so, those who had begun to talk cease to speak. Play, then, should be one means of accompanying children so that they may gradually be reintroduced to the development process, at their own pace.

Normally, children adjust their play to their capabilities ; the "sensitive periods", as Maria Montessori calls them, should be taken into consideration, then. She describes child development as follows.

Before age one month, babies are attracted to colours and sounds. Resemblance does not matter. Anything with lively colours or that makes noise attracts their attention. As soon as their hands are able to grasp, knead and drop objects, rubber toys become valuable companions : they may be pushed and pulled into any shape, despite the fearful screaming of their whistle. Towards age one year, throwing objects is the main concern. Infants are particularly happy if the falling object makes a great deal of noise ; rag dolls and plastic cubes constantly fly around the room, to the joy of the thrower. When baby's first steps are on the agenda, anything that rolls or provides support attracts interest. Toddlers push things, cart-like, eager to explore the world while limiting the risk of bumps and bruised knees. Once they can walk, they pull toys behind them, asserting their autonomy by showing that they are able to do so easily.

As speech develops, a greater variety of toys may be introduced, since they may now be named - all the better to be put to other uses, in some cases.

Imitation games may then be played. Playing now means making believe.

This description requires adaptation to local sociocultural situations. However, it is important that all of these types of props be made available, so that these children may retrieve normal psy-

chomotor development, and also play out their phantasied fears and desires.

PSYCHOTHERAPY

Often psychotherapy is a valuable adjunct, either because the mother-child relationship was already disturbed before malnutrition developed, and was therefore one aetiological factor, or because the occurrence of malnutrition was a shock to the mother-child bonding, within its sociocultural setting.

Psychotherapeutic action, when necessary, should be viewed in two perspectives : as an approach to the child as an individual, and as an approach to the mother-child relationship.

The psychotherapeutic relation

There is no pre-established recipe for child therapy ; each treatment should be a unique adventure shared by the therapist and the child. Patience, receptiveness and attention are required, along with emotional, social and cultural openness. Through transfer, which is the special tie created by psychotherapy, medicalized feeding may be avoided, the child may achieve a structured mental life and discover the desire to exist.

Treatment of the mother-child relationship

As Geber points out, "Babies are structured by their relations with their mother. When one of the two is disturbed, the other is affected. To break out of this vicious circle, therapists work at restoring this bond" (22).

The first step is to bring the mother to accept the idea of therapy. Such mothers are often wounded in their narcissism, with a feeling that they have failed with their child, and a negative image of themselves. Therapy, then, must be comprehensive, englobing the child, the mother, and the child within his or her environment. It necessarily requires follow-up after homecoming, within the child's home setting. It requires that caregivers be extremely accessible, acutely receptive, able to help the relationship along without replacing the mother in her role ; rather than taking action, they should guide both parties toward a satisfying contact, and restore both the child's trust in his or her mother and the mother's self-confidence. There is no such thing as a bad mother : there are only inadequate mother-child relationships.

Martine Lamour writes about endangered relationships. In her words : "by truly seeing the child with humanizing eyes, the therapist helps the real child to exist, and enables the mother to see her child with the feeling that she receives support from her relationship with the therapist, provided it bolsters her narcissism sufficiently. The real child is then born again ; the idea is also to lead the mother to perceive her baby's needs in accordance with his or her age or degree of maturity, not from an educator's perspective but in direct connection with the feelings

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(22) Geber M. Psychothérapie d'un enfant atteint de Kwashiorkor. Psychopathologie africaine, 1988-89 ; 22 (2) : 171-190.

of both mother and baby : that is to say, by developing the mother's ability to identify with her baby" (23).

It is essential that the concept of the "good mother" be upheld, and the positive aspects of the mother's relations with her child be pointed out to her, while the child is allowed to express and develop his or her skills. Parents and child must be helped concomitantly. The child's spectacular physical and medical advances during rehabilitation should be used to catalyse a changed relationship.

EVALUATION

Psychological evaluation is a most valuable tool for use in the rehabilitation of severely malnourished children, provided workers know how to perform it and are aware of its limits.

When beginning care, testing is done to estimate the extent of psychological/affective regression, for adjustment of psychological help. Tests are then used as a tool for evaluating the child's advances, so as to readjust the intervention. In no case should testing be turned into a constraint, with improvement as a requisite. It should be viewed as simply providing indications. Only children whose development stagnates pose problems. Psychomotor development and mother-child relations are linked. Both are disturbed in malnutrition, and both should therefore be evaluated and treated.

Psychomotor tests involve observation of children's responses to strictly defined situations, so as to assess their level of development. Since tests are used in different cultures they should be restandardized for specific contexts. This involves adjustment of procedures (a change of language, for example), but also revisal of what is an acceptable response (some answers are easy for African children but are unknown to their European counterparts) (cf. Children in the Tropics n° 195 - "The Developing Child : Tools for Monitoring").

Evaluating mother-child interaction is important but quite difficult.

Many methods have been developed, but all have their weak points, especially when severely malnourished children are involved.

So-called naturalist observation, which studies the interaction between mother and child in their own environment, has been used, but its limits are attributable to the large number of uncontrollable variables. Some specialists have suggested the study of more clearly defined situations, but interaction is disturbed by the very presence of any observer and also because he or she unavoidably formulates interpretations.

One French research department (INSERM U.292), working in conjunction with several health units, has experimented a simpli-

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(23) Lamour M. Quand la relation est en danger. Le groupe familial (188), 1988 : 61-67.

fied questionnaire for the evaluation of mother-infant interactions. It may be used during twenty-minute visits, with versions for several ages (3, 12, 24 and 36 months).

It studies bodily interaction (the child likes or refuses body contact, the mother is possessive), visual interaction (assessment of the quality of eye contact between mother and child), vocal interaction (use of the voice for communication) and last, gestual interaction (the child imitates the mother's movements, the mother gives objects to her child).

In this type of evaluation, it is important to exert sharp critical judgement as to the validity of a given grid for making interpretations in different sociocultural contexts. Use of such tools seems worthwhile for bringing out certain problems within the mother-child dyad, for which something may be done. It is important to evaluate the quality of the mother-child dyad at the start of treatment. It now seems evident that recovery will not be as good, and possibly will remain incomplete, if this relationship is not a sufficiently active one.

An interesting recent study of two groups of children - one malnourished, the other controls - has been conducted in Mali, using psychological tests and a study of the mother-child dyad (24).

STIMULATION AND HOME FOLLOW-UP

Following hospitalization, these children need monitoring. Psychological follow-up is part of the overall care package along with nutrition education, medical follow-up and social work. It is used to develop understanding of intra-familial relations, to evaluate the child's progress and to teach the family how to provide appropriate stimulation, which is essential to developmental advances.

The psychological/affective environment may be a causal factor in severe malnutrition.

An unsatisfactory mother-child relationship may contribute to the development of severe malnutrition.

Psychological/affective stimulation during nutritional rehabilitation facilitates recovery.

Severe malnutrition disturbs the mother-child relationship.

Great accessibility, an open mind, a receptive attitude with empathy for both mother and child, and an openness to feeling are some of the key features for psychological help, along with ability to reflect a positive, gratifying image for both mother and child.

Evaluation of advances in both the child's psychomotor development and in the mother-child relationship is important for adapting therapeutic interventions to needs, and is a part of the evaluation of rehabilitation.

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(24) Miquel Garcia E, Keita B, Koumare B, Soula G. Malnutrition et troubles relationnels mère-enfant en milieu urbain au Mali. Psychopathologie africaine, 1992 ; 24 (2) : 205-228.

SOCIAL AND ECONOMIC APPROACH

Above all, malnutrition reflects a pathological environment. Just as the nutritional, medical and psychological aspects may be diagnosed and treated, it is both possible and necessary to establish a diagnosis of the family's socioeconomic situation, and to attempt treatment.

It is still too commonly believed that raising the standard of living suffices in itself to reduce malnutrition. While there is some truth in that analysis, it is nonetheless quite restrictive. In fact, a pathogenic environment is generated by a multitude of interdependent causal factors. There are several possible approaches for solving the problems encountered : they may address education, hygiene, better choice of food, the mother-child dyad, etc. Health workers alone are incapable of treating the underlying causes of the ill, but they do have access to the contributing and immediate causal factors for malnutrition, the correction of which is not necessarily costly. Their role is to identify the factors behind the relegation of certain families to the fringes of society, and to attempt to find solutions.

The focus of action here goes under the name of poverty, dire poverty. Families with malnutrition problems are generally socially and economically marginal, and live in a state of chronic poverty, sometimes over several generations. And yet, other families in comparable situations do succeed in subsisting and in raising their children.

TOOLS FOR ANALYSIS

The FAO regularly publishes national food balance sheets showing the types of food and amounts available on the country's internal market. Further, there are occasional national dietary epidemiology surveys, which constitute a point of comparison for the domestic situations encountered.

If the decision to investigate the situation is made, a study may be conducted of just a few families. It should cover three sectors.

Household budget

Investigation of the household budget, based on a financial analysis of the family's purchases and expenses, establishes a detailed account of all expenditures, and more specifically, of the proportion devoted to food and care for children. The purpose is to evaluate the family's standard of living. Links are made between the family size and structure, its income, and the level and type of expenditures. These findings yield indications on the amounts spent on food relatively to the family budget, but say nothing about what is actually eaten.

Food consumption

A survey of household food consumption provides some information on the amounts and types of food eaten by the family. From the economic standpoint, the household forms a consumer unit within the overall system of consumption. Links may then be es-

tablished between the household dietary pattern and malnutrition. On the basis of these findings, it is then possible to gain a better view of the community's nutritional problems.

The survey

Individual food surveys are used to assess the food ration of each member of the family rather than the consumption of the family as a whole. This type of survey is extremely difficult and demanding : it requires that food be weighed immediately before its consumption by each individual. It shows the distribution of food within the family, with the share allotted to the mother and to each child.

The difficulties reside in the method itself, since weighings or estimates based on pre-standardized measures must be repeated over a number of days, but the family must also accept the presence of an outsider, who necessarily disturbs meals. In addition, this type of study is further complicated in those cultures where each member of the family eats directly out of the family dish, without using a personal plate.

Analysis of food-related data and of nutritional status yields some understanding of the dietary and nutritional situation, and leads to proposals for action that is more appropriate to needs and to resources. A better understanding of the degree of hygiene and of living conditions (water, electricity, housing, building materials, overcrowded lodgings, presence of domestic animals, etc.) may complete this study. Special attention will naturally be paid to how meals are prepared and food stored, and to whether at least minimal hygiene is respected.

The causal approach

Ivan Beghin has formulated a causal approach for use at the community level, predicated on several ideas : that for a problem to be dealt with, its causes and mechanisms must be understood, that treatment of the child only is synonymous with treating the symptom of the ailment, and not malnutrition itself, that malnutrition may have a number of aetiologies depending on the region and the individual.

The purpose is to construct a causal model for malnutrition ; one which is specific to a group or region, so as to discover the major causal factors, bring out the links between the different factors and achieve an overall view of the problem within the local context, so as to infer how to deal with it (25).

This type of analysis does not assess the relative weight of one factor in comparison with others, but it does identify chain-reactions, and suggests action to break them. Last, and above all, it is socially dynamic and enhances awareness, since it is performed within and by the community. It is instrumental to exchanges between the population groups involved and professionals, and helps to raise consciousness and to further a multidisciplinary approach to food and nutrition problems.

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(25) Beghin I. L'approche causale en nutrition. Les malnutritions dans les pays du tiers monde. INSERM seminar published by D. Lemonier and Y. Ingenbleek, 1986 ; (136) : 615-628.

SOCIOECONOMIC CHARACTERISTICS

The family

Actually, families gradually slide into undernutrition through a succession of situations in which they are socioeconomically disadvantaged : an illiterate mother, unemployment, difficult living conditions, social isolation, migrations. Each part of the world has its own characteristic nutritionally negative situations, but often the factors are the same, nonetheless.

Family income is frequently low : in poor areas, there is often a direct correlation between income and the amount of calories consumed (26). One special situation worthy of mention, however, is the case of mothers who leave their babies to be cared for by young, totally inexperienced girls who know nothing about children's needs.

The parents' educational level plays a key role in generating malnutrition, not so much in terms of years of schooling but of their general and practical knowledge about food and diet.

Other factors may be mentioned. They include family status (adolescent mother, woman head of household), number of dependents, mother's age, attendance of a social/health unit and knowledge of what services are offered there.

The national and international levels

The distribution of wealth is increasingly unequal, urban development is increasingly sprawling, and the migration of rural populations further compound the downward spiral of farming production ; this produces a growing peri-urban population totally dependent on food purchased on city markets. The ecosystems are being modified, either by natural events or by human intervention. Water shortages thwart agricultural expansion, and deteriorate sanitation as well.

While food aide may be a palliative in some emergency situations, it sometimes results in diminished local food production, changes in the cost of items and the development of new eating habits. There is the risk of a gradual slide from necessary food aide to economic dependency.

Furthermore, when disadvantaged people have access to certain types of food, the pressure of advertising and their lack of knowledge about nutrition-related matters lead them to spend a great deal of money to actually eat quite poorly.

Many development programmes have failed for lack of an analysis of needs, because the people involved did not participate, or because of outside pressure. True national food, diet and nutrition policies must be designed, and industries making use of local products developed, despite international competition.

A THERAPEUTIC ATTITUDE

We have discussed the importance of a stable mother-child dyad : this is achieved through a web of community relations that support the mother through her everyday trials. At the family level, social

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(26) Buffa A. Pour une politique globale de l'alimentation. Les malnutritions dans les pays du tiers monde. INSERM seminar published by D. Lamonier and Y. Ingenbleek, 1986 ; (136) : 641-653.

action is specially important, and may take several forms. The first is educational : the circulation of messages about hygiene, nutrition, child care, home economics. The second involves the improvement of sanitation, in accordance with available means.

Once the diagnosis has been made, the family should be accompanied along the road to social reintegration, through the search for employment as well as through administrative procedures. By helping the family, the social/health team establishes special ties with it and earns the trust of its members, thus facilitating long-term follow-up. It is important to give families a sense of responsibility, and to accompany them in their search for solutions. They must be given confidence and self-esteem, and learn to participate actively in rehabilitation both of the child and of the family as an entity.

Figure 10 : National food and nutrition policies.

At the community level, the establishment of a nutrition centre may serve as a means for families to become aware of the situation, and hence to become active and dynamic.

At the national level, when malnutrition persists in a region, the policy-making officials should undertake a comprehensive analysis and be determined to implement a truly effective food and agricultural policy through involvement of a number of sectors at both the national and the international levels (cf. figure 10).

A social diagnosis should be made, in conjunction with other disciplines, the outcome being the definition of appropriate interventions.

The community should take an active part in the rehabilitation process.

The ties created by this contribution to the reintegration process should help extend long-term follow-up of both the child and the family.

EVALUATION OF REHABILITATION PROGRAMMES

THE PURPOSE OF EVALUATION

It is essential that every rehabilitation programme be evaluated, so as to draw conclusions from past work, for educational purposes, but also so that the team's activities may be adjusted to local needs.

Evaluation supposes that hypotheses have been formulated at the outset regarding the objectives to be achieved and the limits of the action (number of children in care, estimated length of in-patient and home care, objectives for compensatory growth and development, social help, etc.).

Evaluation is done on two levels : evaluation of how the centre functions and of its effectiveness in combating malnutrition in the area. The first level aims at improving the efficiency of team functioning, the second at improving the adequacy of the centre to its task. Both orientations aim at optimizing action and attaining the best possible therapeutic intervention at the lowest cost.

Three objectives should be pursued :

- making sure team work is adapted to the needs of the region ;

- achievement of the best possible cost/efficiency ratio ;

- analysis of the data collected, so as to develop prevention programmes appropriate to local conditions through the identification of at-risk families and preventive action directly aimed at at-risk social groups. A quarterly review and accurate annual accounting seem to be necessary if these data are to be adequately exploited.

General information on functioning

A number of indicators selected at the start of the activity yield a picture of how the centre is functioning. The data, collected regularly, should constitute useful, accurate information. Before deciding to collect a given piece of information routinely, there should be a clear definition of what it will measure and how it will be used.

It is important to evaluate the work load of the different members of the health team in accordance with their qualification and the number of children. Everyone should have a definite part to play and shoulder responsibility for it.

Estimation of the work load requires that the number of children in care at the centre and in home follow-up be quantified per month : the centre should not exceed its capacity for care, since the children then receive lower-quality attention, and there is a greater risk of epidemics. One key point requiring clarification is how children are recruited : where do they come from, who refers them to the centre, are all children requiring treatment reached?

The characteristics of children treated by the centre are analysed (distribution by age, gender, place of residency, social status, severity of case, etc.) to achieve a clearer picture of the children treated by the centre.

The number of children who leave the centre each month is calculated :

No. of exiting children = drop-outs + transfers + deaths + discharges*

The mean length of sojourn (MLS) is calculated as follows :

$$MLS = \frac{\text{Sum of individual lengths of sojourn in the centre}}{\text{Number of individual sojourns}}$$

Only children who leave with the consent of the staff are counted here, to the exclusion of deaths, drop-outs and transfers.

The mean length of sojourn varies from one centre to another, ranging from 3 weeks to several months, and depends on the criteria for discharge defined at the outset.

Calculation of the date of death with reference to the admission date may elucidate some treatment or recruitment problems.

Another indicator that may be a valuable guide is the drop-out rate : that is, the number of children who dropped out of care in ratio to the number admitted to the centre. It shows the extent of the population's trust and belief in the programme. Surveys show that these rates are frequently high : over half in one Bamako centre, 39 % in a centre in Niger. It is important to understand the causes of dropping out, which often reflect a lack of communication with parents, with mothers who feel that their child is not making progress, and therefore have the impression that they are wasting their time.

This points to a difficulty in managing care and relations with families, but also to the mothers' domestic obligations. The conditions of care delivery must be carefully defined. Perhaps mothers should be offered some advantages to compensate for what they sometimes view as a waste of time. Indeed, during the time spent at the centre, they take care of the needs and meals of one child, but do not work or take care of the rest of the family. A contract should be drawn up, to make families aware of their responsibilities : a care contract, specifying the objectives of the treatment programme and the obligations of both the centre and the family, at the outset.

Evaluation of activities

At the medical level, protocols for types of care adapted to needs may be implemented and preventive interventions designed in accordance with the medical conditions encountered, children's vaccinal coverage, responses to treatment and the laboratory analyses performed.

At the nutrition level, it is important to evaluate the quality of recovery. One indicator is mean weight gain during phase 3, ex-

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* *Children leaving the centre with official consent, and followed up at home.*

pressed as g/kg/day, in comparison with means. A very low figure should lead to the re-examination of the nutritive value of the meals served. The acceptability of the meals for the children may also be estimated, through analysis of the amounts eaten, showing which dishes are inappropriate. The nutritive value of meals should be calculated using food composition tables, so as to evaluate coverage of calorie and protein requirements, and to adjust meal value to needs.

Another element to be taken into consideration is the cost of meals : the price of ingredients, amounts, fuel, etc. The cost of meals is then evaluated, so as to select formulas that are particularly appropriate to the financial situation of the families involved, and to offer preparations with the best nutritive value/cost ratio.

Psychological aspects are perhaps the most difficult to evaluate. The tests used to monitor children at the centre and at home may be used ; since children's progress is often seen to slow down when they return home, follow-up of progress makes it possible to give advice on care, and to determine the quality and the amount of attention required by each child.

Socioeconomic data are useful for making an aetiological diagnosis and adapting the team's interventions to the most vulnerable groups.

Accurate monthly accounting should be done, based on the budgetary entries, including salaries for the personnel, spending for food and treatment (drugs, laboratory testing), running costs (facilities, fuel, office supplies, etc.) and equipment. The running cost of the centre is then calculated, item by item, each month. An estimated budget may then be projected, the centre's objectives may be adjusted to its financial possibilities, and the acceptable cost of participation calculated for families and for the various contributing agencies.

Once the number of children who recover each month is determined, the per-child cost of rehabilitation may be calculated.

Evaluation of the programme

This type of evaluation is delicate, but is helpful in orienting the activity of the centre. Answers should be sought to two questions.

Coverage

Does the centre respond to local needs? Nutrition surveys made in the region determine the theoretical prevalence of malnutrition ; on the basis of the number of children under age 5, the number of malnourished children in the region covered by the centre may be estimated, and the actual coverage calculated.

$$\text{Coverage} = \frac{\text{No. of children in care}}{\text{Theoretical no. of malnourished children}}$$

The impact of the centre's activity on nutritional status in the area may be determined by use of repeated nutrition surveys yielding information on the evolution of malnutrition in the region. It is difficult to infer a causal relationship due to the centre, since many

factors are involved in any rise or fall in the number of malnourished children. Conversely, it is both feasible and necessary to determine the effectiveness of this type of programme, but this requires relatively long-term monitoring.

A better approximation of the characteristics of children attending the centre in comparison with the overall population helps to identify at-risk groups on the regional level.

Is the action effective? The recovery rate provides a partial answer to this question.

Recovery rate

$$\text{Recovery rate} = \frac{\text{No. of children defined as rehabilitated}}{\text{No. of children in care}}$$

Criteria for admission and discharge of children must be defined, on the basis of clinical, anthropometric, behavioural and social requirements.

The relapse rate may also be an indication. Relapses frequently occur during the first month after leaving the centre.

Relapse rate

$$\text{Relapse rate} = \frac{\text{No. of children re-entering the centre}}{\text{No. of children in care}}$$

The duration of home follow-up is determined at the start, and depends on the possibilities of the centre.

The cost/efficiency ratio cannot be calculated without relatively long-term follow-up of children. The work of the staff does not stop when the child leaves the centre, and at least minimal home follow-up must be planned ; it varies with the family context, the possibilities of the centre and the objectives of rehabilitation. If the results of the child's stay in the centre are not evaluated some time later, no reliable conclusions can be drawn as to the value of the rehabilitation programme.

EFFECTIVENESS OF PROGRAMMES

The actual experience of nutritional rehabilitation centres shows that they are not always as successful as they should be, for several reasons. The objectives are often too ambitious, overall analysis is lacking, the intervention is not multidisciplinary and there is no corrective self-evaluation.

Objectives should be restricted to what is feasible for the staff ; however, be this as it may, action can never be anything but a palliative in the absence of political and economic awareness at the highest national and international levels.

This type of rehabilitation, which was quite popular in the 1970s, has tended to be discarded and replaced by preventive action. There is no doubt that it is more cost-effective to avoid the downgrading of nutritional status than to rehabilitate a severely malnourished child. This is true when action is directed to individual children, but when preventive programmes are set up, the problem is how to reach those population groups that are in real need of

the intervention. The effectiveness of a preventive programme is "watered down" in the overall population. Preventive action definitely is the foremost weapon in the fight against malnutrition, but it does seem equally essential that children who are already severely malnourished be given care.

Rehabilitation cannot be done at home, at least during the first few weeks. Treatment in hospital units is not appropriate to the highly specific needs of malnourished children. Moreover, a number of researchers have shown that the per diem cost is multiplied by 4 to 15, in comparison with a renutrition centre.

Renutrition centres are now seen to be the best solution. In Chile, these findings have led to the creation of CONIN (the Chilean Nutritional Foundation). Between 1975 and 1980, 33 centres were set up, at a cost of 8 million US dollars. They provided care by multidisciplinary teams for 33,000 children under age two. Monckeberg has drawn the following conclusions from this experience (27) : rehabilitation took less time than in hospitals, the mortality rate was lower, and the rehabilitation of these children had positive effects on the families' social and economic development.

A follow-up study of 35,000 rehabilitated children has shown that only 4 % did not retrieve normal growth, and 1 % suffered relapses. The cost of care was 8 US$/day in these centres, versus 42 $/day in a hospital. This type of centre reduces the number of admissions to hospitals.

Furthermore, in our opinion, these programmes are useful in identifying at-risk families, for whom preventive programmes will be more effective. Since these centres are located within the community, they demedicalize the problem of malnutrition and foster its management by the community.

Dynamic evaluation of nutritional rehabilitation programmes is essential, so that their functioning may be improved and their action adjusted to local needs.

Global care programmes in units specially designed for this type of intervention and run by a staff with a deliberately multidisciplinary approach seem to be quite successful.

The cost of recovery for a child in a rehabilitation centre is lower than the cost of recovery in a hospital.

Long-term follow-up is required for evaluation of the impact of this action.

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(27) Monckeberg F. Treatment of the malnourished child. Nestlé Nutrition Workshop Series (19), 1990.

CONCLUSION

All in all, malnutrition is an extremely complex phenomenon. There is no single clinical picture but rather a great many forms resulting from a variety of aetiological factors. The pathophysiology of severe malnutrition changes considerably with the environment, and there are a great many different individual situations. Given the extremely variable, multifactorial nature of this condition, only a multidisciplinary team whose work covers an extensive range of action can have a lasting effect.

A comprehensive analysis at the local level, along with an understanding of the ecology of nutrition, are necessary prerequisites to the formulation of long-term solutions.

The key role of mothers in rehabilitation has been amply proved. Nutrition programmes require a combination of preventive and curative activities, the target of which is the mother-child dyad, with care for mothers during pregnancy and lactation, and perhaps even prior to conception with the development of preventive programmes for adolescents and women of child-bearing age.

In the field of nutritional rehabilitation, as in many others, special attention should be paid to popular education. This education implies a trusting relationship and exchanges, constant receptiveness during health workers' many contacts with parents, children and young people. They must seize every opportunity to understand people's behaviour when faced with different events, and to transmit educational messages which are both consistent with scientific knowledge and respectful of the traditional values, customs and beliefs of families.

These rehabilitation actions may seem costly and difficult to implement. They definitely require ongoing, dynamic evaluation to make sure that interventions are adapted to local needs. There is no single solution capable of eradicating malnutrition everywhere, but it does seem feasible to develop analytic models for use by health officials in conjunction with the communities themselves, so as to help them set up their own lasting solutions.

These are not new ideas : they were first expounded in writings of the 1960s. The present paper should not be taken as a model, but rather as thought-provoking material for use by people who are developing their own programme.

Many questions about the pathophysiology of severe malnutrition are still unanswered. Knowledge, both in the social sciences and in biology, is open to change, and constant up-dating is required if the care provided for these children is to be improved.

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SEVERE MALNUTRITION : A GLOBAL APPROACH

1993 - N° 208-209

The author, who spent a year with a Bolivian health team working at the German Urquidi Hospital in Cochabamba, presents the nutritional rehabilitation programme developed there for children hospitalized for severe malnutrition. A bibliographic survey of investigations in this area around the world completes the picture.

Rehabilitation does not stop at the nutritional side of recovery, with its clinical, biological, infectious, anthropometric and dietary facets : it also considers psychomotor development, as well as the child's sociocultural and affective environment. This global care, described in numerous scientific studies, has clearly proved that far more prompt recovery, with much milder aftermaths, may be attained when action concerns itself with the different aspects of children's development, rather than with food intake only.

The author emphasizes the need for mothers to participate actively in this programme, and the importance of situating the mother-child dyad in its family context and cultural setting. Follow-up of the child who returns home after a stay at the rehabilitation centre is seen to be an essential phase, if the child is to readjust properly to the home setting.

Once again, if need be, this journal focuses on the importance of a global approach to children, be they healthy or ill.

"Sowing seeds in the school garden". Picture by Doctor Edmundo ESTEVEZ. The ANDES programme in Ecuador.

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